Naval Postgraduate School
Monterey, California 93943-5138

NPS-09-03-009

Compilation of

Theses Abstracts

September 2003

Office of the Associate Provost and Dean of Research
Naval Postgraduate School

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PREFACE

This publication contains restricted abstracts (classified or restricted distribution) of theses submitted for the degrees Doctor of Philosophy, Master of Business Administration, Master of Science, and Master of Arts for the September 2003 graduation. Classified and restricted distribution abstracts are listed on the NPS SIPRnet.

This compilation of abstracts of theses is published in order that those interested in the fields represented may have an opportunity to become acquainted with the nature and substance of the student research that has been undertaken. Copies of theses are available for those wishing more detailed information. The procedure for obtaining copies is outlined on the last page of this volume.

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NPS Research, a tri-annual publication highlighting faculty and student research and *Summary of Research*, an annual publication of research projects and publications, are also available on-line.

INTRODUCTION

Mission

The Naval Postgraduate School (NPS) was established to serve the advanced educational needs of the Navy. The broad responsibility of the school is reflected in its stated mission:

> Increase the combat effectiveness of U.S. and allied armed forces and enhance the security
> of the U.S.A. through advanced education and research programs focused on the technical,
> analytical, and managerial tools needed to confront defense related challenges of the future.

To fulfill its mission, the Naval Postgraduate School strives to sustain excellence in the quality of its instructional programs, to be responsive to technological change and innovation in the Navy, and to prepare officers to introduce and utilize future technologies.
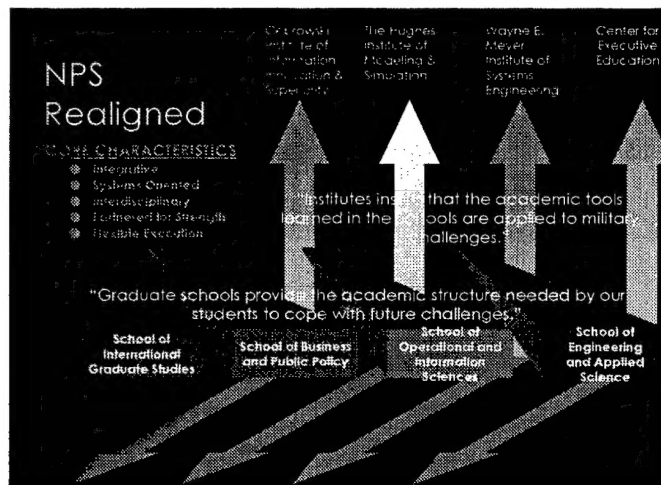
The research program at NPS exists to support the primary mission of graduate education. Research at NPS:
- maintains upper division course content and programs at cutting edge;
- challenges students with creative problem solving experiences on DoD relevant issues;
- advances DoN/DoD technology;
- solves warfare problems; and
- attracts and retains quality faculty.

Academic Programs

To meet its educational requirements, the Navy has developed a unique academic institution at the Naval Postgraduate School through the use of specially tailored academic programs, and a distinctive organization trying academic disciplines to naval and joint warfighting applications.

The Naval Postgraduate School has realigned its education and supporting research programs to achieve three major goals: 1) academic programs that are nationally recognized and support the current and future operations of the Navy and Marine Corps, our sister services, and our allies; 2) institutes that focus on the integration of teaching and research in direct support of the four pillars of Joint Visions 2010 and 2020 and their enabling technologies; and, 3) executive and continuing education programs that support continuous intellectual innovation and growth throughout an officer's career.

Programs of Graduate Studies at NPS are grouped as follows:

Graduate School of Operational and Information Sciences

... Computer Science
... Electronic Warfare Systems International
... Information Systems and Operations
... Information Systems and Technology
... Information Warfare

... Operations Analysis
... Operations Logistics
... Software Engineering
... Defense Analysis

Graduate School of Engineering and Applied Sciences

... Aeronautical Engineering
... Aeronautical Engineering Avionics
... Combat Systems Science and Technology
... Electronic Systems Engineering
... Meteorology

... Meteorology and Oceanography
... Operational Oceanography
... Oceanography
... Reactors/Mechanical Engineering
... Naval/Mechanical Engineering

Graduate School of Business and Public Policy

... Systems Acquisition Management
... Resource Planning and Management for
    International Defense
... Financial Management
... Transportation Management
... Defense Systems Analysis
... Systems Acquisition Management
... Information Systems Management
... Defense Systems Management
    (International)

... Contract Management
... Manpower Systems Analysis
... Transportation Management
... Leadership Education and Development
... Acquisition and Contract Management
... Program Management
... Material Logistics Support Management
... Supply Chain Management

School of International Graduate Studies

... National Security and Intelligence
    ... Middle East/Africa/South Asia
    ... Far East/South-East Asia/Pacific
    ... Western Hemisphere
    ... Europe/Russia/Central Asia
... Civil-Military Relations

... Defense Decision Making and Planning
... Homeland Security Leadership
    Development
... International Security: Post Conflict
    Security Building

Interdisciplinary Curricula

... Modeling, Virtual Environments, and
    Simulation
... Product Development
... Systems Engineering and Analysis

... Undersea Warfare
... Space Systems Engineering
... Space Systems Operations
... Systems Engineering Management

Students

The student body consists of U.S. officers from all branches of the uniformed services, civilian employees of the federal government and military officers and government civilian employees of other countries. Resident degree/subspecialty student population for December 2003 is shown in Figure 1 on the following page.

INTRODUCTION

**Figure 1: Resident Degrees/Subspecialty Student Population for December 2003
(Total Enrollment: 1,443)**

*National Guard, U.S. Army Reserve, U.S. Coast Guard

Academic Degrees
Although the curricula are tailored to address defense requirements, they are developed within the framework of classical academic degrees, meeting the highest academic standards. Each curriculum leads to a master's degree; however, additional study can lead to either an engineer's degree or the doctor's degree. Below is a listing of the degrees offered at NPS:

Master of Arts Degrees
National Security Affairs
Security Studies

Master of Business Administration

Master of Science Degrees
Aeronautical Engineering
Applied Mathematics
Applied Physics
Applied Science
Astronautical Engineering
Computer Science
Contract Management
Defense Analysis
Electrical Engineering
Engineering Acoustics
Engineering Science
Information Systems and Operations
Information Technology Management
Joint Meteorology and Physical Oceanography
Leadership and Human Resource Development
Management
Materials Science and Engineering
Mechanical Engineering
Meteorology
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography
Physics
Product Development
Program Management

Software Engineering
Space Systems Operations
Systems Analysis
Systems Engineering
Systems Engineering Management
Systems Technology

Engineer Degrees
Astronautical Engineer
Electrical Engineer
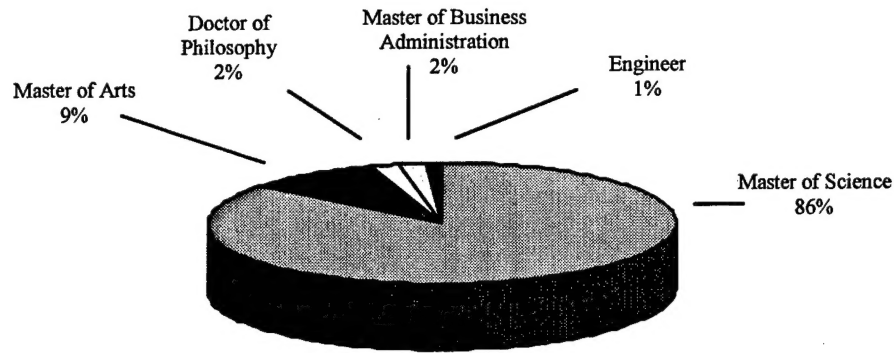Mechanical Engineer

Doctor of Philosophy
Astronautical Engineering
Applied Mathematics
Applied Physics
Computer Science
Electrical Engineering
Engineering Acoustics
Materials Science and Engineering
Mechanical Engineering
Meteorology
Modeling, Virtual Environments, and Simulation
Operations Research
Physics
Physical Oceanography
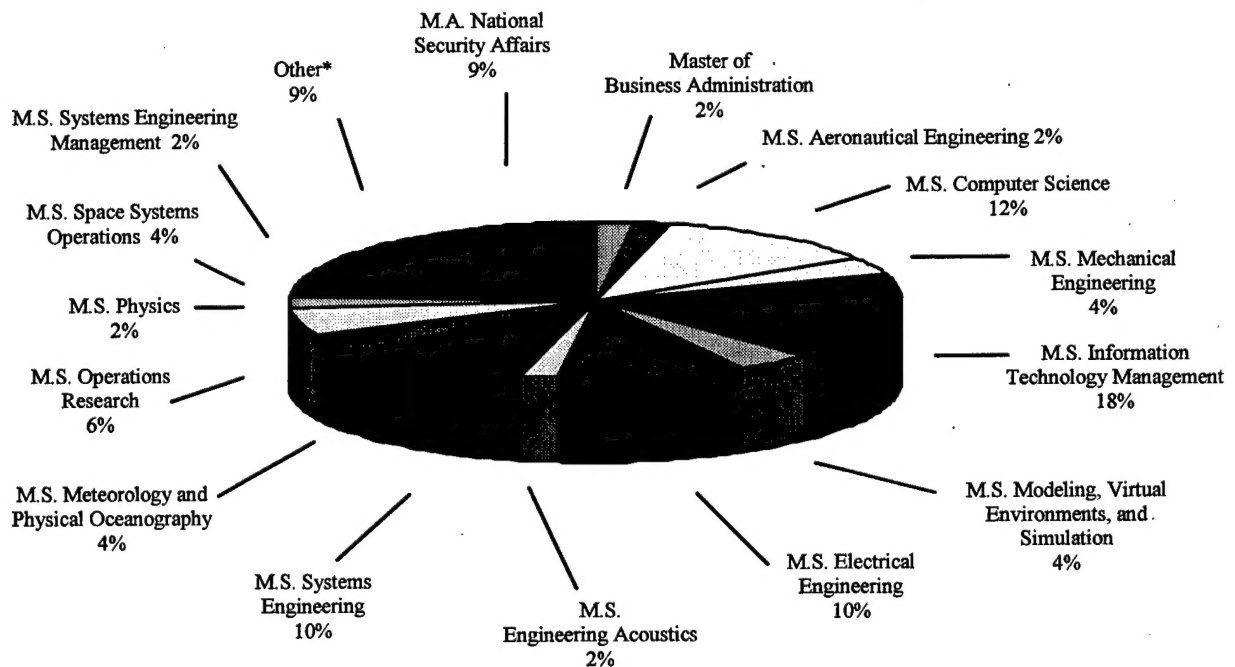Software Engineering

Doctor of Engineering
Astronautical Engineering
Engineering Acoustics
Mechanical Engineering

INTRODUCTION

There were 160 degrees conferred in December 2003. Figure 2 indicates the distribution of degree type; Figure 3 indicates the degree conferred.

Figure 2. Distribution of Degree Type
(160 Degrees Conferred)

Figure 3. Degrees Conferred in December 2003
(160 Degrees Conferred)

*Ph.D. Modeling, Virtual Environments, and Simulation (1); Ph.D. Physical Oceanography (1); Ph.D. Software Engineering (1); Mechanical Engineer (1); M.S. Applied Science (2); M.S. Contract Management (1); M.S. Engineering Science (2); M.S. Information Systems and Operations (2); M.S. Management (2); M.S. Meteorology (1); M.S. Systems Technology (1)

Thesis

The thesis is the capstone achievement of the student's academic endeavor at NPS. Thesis topics address issues from the current needs of the Fleet and Joint Forces to the science and technology that is required to sustain long-term superiority of the Navy/DoD.

Students, with their faculty advisors, provide a very unique capability within the DoD for addressing warfighting problems. This capability is especially important at the present time when technology in general, and information operations in particular, are changing rapidly. Our officers must be able to think innovatively and have the knowledge and skills that will let them apply technologies that are rapidly being developed in both the commercial and military sectors. Their unique knowledge of operations, when combined with a challenging thesis project which requires them to apply their focused graduate education, is one of the most effective methods for both solving Fleet/Joint Force problems and instilling the life-long capability for applying basic principles to the creative solution of complex problems.

NPS is unique in its ability to conduct classified research. Restricted theses are available on the NPS SIPRNET.
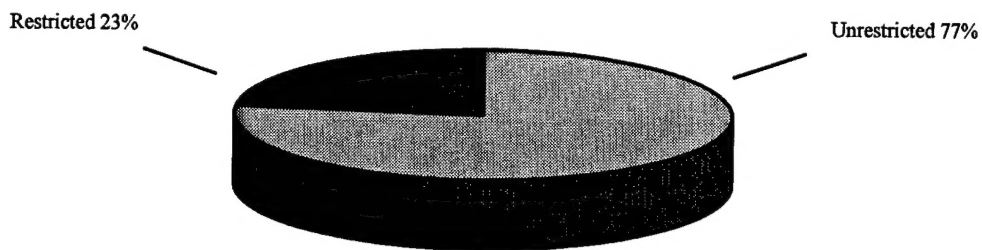
Restricted 23%   Unrestricted 77%

Figure 4. Classification of Theses

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MASTER OF ARTS

ADVANCED DEGREES

Doctor of Philosophy
Mechanical Engineer

DOCTOR
OF
PHILOSOPHY

MODELING REDUCED HUMAN PERFORMANCE AS A COMPLEX ADAPTIVE SYSTEM

Joerg C.G. Wellbrink-Major, German Army
M.S., German Armed Forces University Munich, 1985
M.S., Naval Postgraduate School, 1998
Doctor of Philosophy in Modeling, Virtual Environments, and Simulation-September 2003
Advisor: Mike Zyda, Modeling, Virtual Environments, and Simulation Institute
Committee Members: Maria Rasmussen, Department of National Security
Ted Lewis, Department of Computer Science
Rudolph P. Darken, Department of Computer Science
John Hiles, Modeling, Virtual Environments, and Simulation Institute
CDR Lisa Curtin, USN, Dean of Students, Naval Postgraduate School

Current cognitive models not only lack flexibility and realism, they fail to model individual behavior and reduced performance. This research analyzes current cognitive theories (namely, symbolism, connectionism, and dynamicism). It hypothesizes that reduced human performance can be best modeled as a complex adaptive system.

The resulting multi-agent model "Reduced Human Performance Model (RHPM)" implements reactive agents competing for cognitive resources. Lack of resources is used to trigger the simulation of imperfect perception and imperfect cognition.

The simulation system is calibrated with human experimental data in scenarios involving vigilance decrement, wherein vigilance is decreased during the first 30 minutes of a screening task. RHPM is then validated against previous unknown vigilance task scenarios.

RHPM generates realistic reduced human performance with a new cognitive modeling hypothesis. The developed multi-agent system generates adaptive and emergent behavior. Its use for computer generated forces (i.e. radar screen operator) would improve the realism of simulation systems by adding human like reduced performance.

The main contribution of this research is the development of a well suited tool to mediate between vigilance theories such as signal detection theory and experimental data. It generates insights, creating likely hypotheses to improve the theories.

KEYWORDS: Vigilance, Cognitive Modeling, Complex Adaptive System, Human Performance, Personality, Cognitive Psychology

SENSITIVITY OF A NAVY REGIONAL OCEAN MODEL TO HIGH-RESOLUTION ATMOSPHERIC MODEL AND SCATTEROMETER WIND FORCING

Henry Jones-Commander, United States Army
B.S., United States Naval Academy, 1979
Doctor of Philosophy in Physical Oceanography-September 2003
Advisor: Mary L. Batteen, Department of Oceanography
Committee Members: Roland W. Garwood, Department of Oceanography
Curtis A. Collins, Department of Oceanography
Wendell A. Nuss, Department of Meteorology
Douglas K. Miller, Department of Meteorology

As the focus of Navy attention shifts to littoral regions, higher resolution and re-locatable nested models have been developed to improve shallow-water operations for ocean prediction. One of the scientific and technical challenges is to determine accuracy of ocean models on high-resolution grids needed to meet operational requirements for ocean prediction. A series of 14-day experiments are performed to evaluate

the sensitivity of a regional ocean model to low-resolution Navy Ocean Global Atmospheric Prediction System (NOGAPS) versus high-resolution Coupled Ocean Atmospheric Model Prediction System (COAMPS) wind forcing that includes scatterometer data from synthetic QuikSCAT (quick scatterometer mission) observations. Atmospheric model wind stress/wind stress curl and Pacific West Coast ocean model (PWC) surface and subsurface current/temperature model results are compared and analyzed. The results show that there is significant sensitivity in sea surface current and wind stress variability to the choice of atmospheric model grid resolution and the insertion of high-resolution satellite data. In coastal areas, increasing atmospheric model resolution produces a finer depiction of the variability observed near capes and promontories. Insertion of QuikSCAT data produces a statistical difference but no significant difference in the model fields. The ocean model runs have the expected climatological features and variability. The higher wind stress in COAMPS causes the ocean model to predict higher velocity currents and better-defined eddies near capes and promontories. However, comparisons to observations show that using models with the same high-resolution for all regions may not be an efficient use of computer resources.

KEYWORDS: Sigma Coordinate Model, NOGAPS, COAMPS, Scatterometer, High-resolution

EVOLVING A SIMULATION MODEL PRODUCT LINE SOFTWARE ARCHITECTURE FROM HETEROGENOUS MODEL REPRESENTATIONS

Kevin J. Greaney-Colonel, United States Army
B.A., Northeastern University, 1974
M.S., Shippensburg University, 1977
M.A., Webster University, 1992
Doctor of Philosophy in Software Engineering-September 2003
Advisors: Luqi, Department of Computer Science
James Bret Michael, Department of Computer Science

National- and Department-level decision-makers expect credible Department of Defense models and simulations (M&S) to provide them confidence in the simulation results, especially for mission-critical and high-risk decisions supporting national security. Many of these large-scale, software-intensive simulation systems were autonomously developed over time, and subject to varying degrees of funding, maintenance, and life-cycle management practices, resulting in heterogeneous model representations and data. Systemic problems with distributed interoperability of these non-trivial simulations in federations' persist, and current techniques, procedures, and tools have not achieved the desired results. The Software Architecture-Based Product Line for simulation model representations, employing Architecture Readiness Levels presented in this dissertation provides an alternative methodology. The proposed four-layered M&S software architecture-based product line model enables the development of model representations supported by readiness levels. Each layer reflects a division of the software architecture-based product line. The layer represents a horizontal slice through the architecture for organizing viewpoints or views at the same level of abstraction, while the software architecture-based product line represents a vertical slice. A layer may maintain multiple views and viewpoints of a software architecture-based product line. A Domain Metadata Repository prescribes the interaction between layers. The Domain Integrated Product Development Team concept is introduced.

KEYWORDS: Model and Simulation, Software Architecture, Product Lines, Architecture Description Languages, ADL, Extensible Markup Language, XML, Verification, Validation, Readiness Levels, Interoperability, Heterogeneous Model Representations, Heterogeneous Data, Credibility, Confidence, Distributed Development

MECHANICAL
ENGINEER

**PERFORMANCE AND FLOW REGIMES IN PLANE 2-D DIFFUSERS WITH EXIT CHANNELS
AT LOW REYNOLDS NUMBERS**
Epameinondas Trivilos-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1995
Mechanical Engineer-September 2003
Master of Science in Mechanical Engineering-September 2003
Advisor: Knox T. Millsaps, Department of Mechanical Engineering

A numerical study on laminar incompressible flows in 2-D straight walled diffusers in the low Reynolds number regime (105-1048) is presented to investigate performance and various flow regimes that might exist. Tail channels are situated downstream from the diffusers. Geometries with area ratios AR=1.15 to 5 and non-dimensional lengths of L/W1=1 to 48 are considered. Results are presented in terms of flow regime maps for Reynolds numbers of 105, 210, 314, 420, 629, 1,048 and pressure recovery coefficients maps for Re numbers of 105, 210, 314, 420 and 629. In addition, time resolved simulations of impulsively starting flow are considered at Re=210, 314 for 12 geometries on the flow regime map. Four flow regimes can be distinguished depending on diffuser geometry. With increasing divergence angle the flow goes from attached to symmetrically separated to asymmetrically separated and finally to a non 2-D pattern respectively.

KEYWORDS: Diffusers, Low Reynolds, Diffuser Performance, Diffuser Flow Regime

6

MASTER
OF
BUSINESS ADMINISTRATION

MASTER
OF
BUSINESS ADMINISTRATION

THE XM777 JOINT LIGHTWEIGHT 155MM HOWITZER PROGRAM (LW155): A CASE STUDY IN PROGRAM MANAGEMENT CONSIDERATIONS CONCERNING THE USE OF NATIONAL ARSENAL ASSETS
Philip R. Clark-Captain, United States Army
Master of Business Administration-September 2003
Advisors: David F. Matthews, Graduate School of Business and Public Policy
Raymond E. Franck, Graduate School of Business and Public Policy

The end of the Cold War signaled hard times ahead for both public and private manufacturers in the Nation's Defense Industry. Army-controlled manufacturing Arsenals, subject to Governmental control and requirements to maintain excess mobilization capacity, found themselves increasingly unable to compete with private industry on cost. Set-aside protectionist legislation, especially the Army Arsenal Act and the Stratton Amendments, played an increasing role in the ability of the Arsenals to obtain work. The Army Arsenal Act applies to "make or buy" decisions and the Stratton Amendment restricts the transfer of large-caliber cannon technology to foreign nations. The LW155 Joint Program Office has dealt with both statutes because it manages a multi-national weapon system with a large-caliber cannon and is scheduled for production by the Army. This report uses the LW155 Program as a case study to examine three areas of importance to a Program Manager: the application of the Army Arsenal Act to joint service programs; the prime contractor's ability to control the origin of component parts; and the constraints upon multi-national production caused by the Stratton Amendment.

KEYWORDS: XM777, Joint Lightweight 155mm Howitzer, LW155, Army Arsenal Act, Stratton Amendment, Watervliet Arsenal, WVA, Rock Island Arsenal, RIA

BUILDING A COLLABORATIVE PARTNERSHIP BETWEEN CAMP S.E.A. LAB AND THE NAVAL POSTGRADUATE SCHOOL
Edward Martinez-Lieutenant Commander, United States Navy
Master of Business Administration-September 2003
Eileen Regan-Captain, United States Marine Corps
Master of Business Administration-September 2003
Chad Ridder-Lieutenant, United States Navy
Master of Business Administration-September 2003
Advisors: Gail Fann Thomas, Graduate School of Business and Public Policy
Jeffrey Cuskey, Graduate School of Business and Public Policy
Don Brutzman, Modeling, Virtual Environments, and Simulation Institute

The purpose of this project was to work with Camp S.E.A. Lab Monterey Bay to develop an approval strategy to lease government property from the Naval Postgraduate School (NPS) on a services-in-kind payment plan. The goal was to help form a collaborative partnership between Camp S.E.A. Lab and NPS. In support of the potential partnership between Camp S.E.A. Lab and NPS, the students reviewed Camp S.E.A. Lab's current long-range business plan and identified recommendations for the creation of a revised plan. The terms and conditions that are required for the type of lease Camp S.E.A. Lab will be requesting were identified and delivered to Camp S.E.A. Lab. The students also developed a Strategic Communication Plan, which identified the requirements that are necessary to form a mutually beneficial partnership with NPS.

KEYWORDS: Collaborative Partnerships, Government Contracts, Business Plans

MASTER OF SCIENCE

Aeronautical Engineering
Applied Science
Computer Science
Contract Management
Electrical Engineering
Engineering Acoustics
Engineering Science
Information Systems and Operations
Information Technology Management
Management
Mechanical Engineering
Meteorology
Meteorology and Physical Oceanography
Modeling, Virtual Environments, and Simulation
Operations Research
Physics
Space Systems Operations
Systems Engineering
Systems Engineering Management
Systems Technology

MASTER OF SCIENCE
IN
AERONAUTICAL ENGINEERING

OPTIMIZATION OF A DUAL FOIL FLAPPING DEVICE
Craig J. Paganucci-Ensign, United States Naval Reserve
B.S., Georgia Institute of Technology, 2002
Master of Science Aeronautical Engineering-September 2003
Advisor: Kevin D. Jones, Department of Aeronautics and Astronautics
Second Reader: Max F. Platzer, Department of Aeronautics and Astronautics

Aquatic animals, such as dolphins and tuna, have the ability to swim and maneuver at much greater capacity than any man-made device. If their propulsion methods could be replicated mechanically, the benefits to underwater propulsion would be great. A dual foil pitching-plunging device is used to replicate the basic swimming motion of a dolphin. Numerical simulations are used to predict the behavior of a single foil configuration and its wake. The numerical results are used to predict the behavior of the device and to better direct the experimental study. Experimentally, both a single and dual foil configuration are optimized, with the goal being to determine the optimal conditions for maximizing aft foil thrust production.

KEYWORDS: Flapping Wing Propulsion, Underwater Propulsion, Navier Stokes, Numerical Prediction

MASTER OF SCIENCE
IN
APPLIED SCIENCE

"FOLLOW THE LEADER" TRACKING BY AUTONOMOUS UNDERWATER VEHICLES (AUVS) USING ACOUSTIC COMMUNICATIONS AND RANGING

Daniel P. Kucik-DoD Civilian
B.S., University of Florida, 1999
Master of Science in Applied Science (Robotics)-September 2003
Advisors: Don Brutzman, Modeling, Virtual Environments, and Simulation Institute
Anthony Healey, Department of Mechanical Engineering
Douglas P. Horner, Department of Information Science

With advances in computer and sensor technologies, autonomous underwater vehicles (AUVs) are now capable of reaching a level of independent action once thought impossible. Through the use of cooperative behaviors, it is possible to further increase their autonomy by allowing multiple operating AUVs to simultaneously coordinate their activities in order to improve the efficiency and effectiveness of the overall system.

This thesis research defines the algorithms and rules needed to perform "follow the leader" cooperative behaviors during AUV rendezvous. This is a low-level first step towards more sophisticated cooperative behaviors, such as swarming or new forms of obstacle/trap avoidance. The approach taken here differs from previous research in that it does not rely on beacons or locator sensors, but instead uses ranging and intention information shared between the vehicles using acoustic communications.

Several tools and algorithms are presented to support the future development of cooperative behaviors. In particular, a previously developed 3D virtual world simulator that utilizes dynamics-based vehicle models has been enhanced to support multiple simultaneously operating vehicles. Finally, a procedural algorithm is shown to correct the relative navigation errors between two vehicles through the use of vehicle-to-vehicle communications and ranging information obtained via acoustic modems.

KEYWORDS: Autonomous Underwater Vehicle, Cooperative Behaviors, Relative Navigation Error Correction, Follow-the-Leader

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ALLOCATING AIR FORCE CAREER FIELD ACCESSION TARGETS: AN OPTIMIZATION BASED TOOL

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B.S., United States Air Force Academy, 2002
Master of Science in Applied Science (Operations Research)-September 2003
Advisor: David H. Olwell, Department of Operations Research
Second Reader: W. Matthew Carlyle, Department of Operations Research

The United States Air Force (USAF) officer accession sources annually produce three thousand non-rated line officers who must be classified into career fields. Under the current system, many career field accession goals are not met. This mismatch occurs primarily because of unreasonable targets set for the various commissioning sources. This thesis presents an optimization-based target allocation tool that mitigates the existing mismatch between long-term manpower needs and near-term accession source outputs. This Java-based application enables users to weight multiple objectives, set priorities for filling various career fields, solve for optimal targets, and then explore results, presented in the form of interactive tables and charts. Within a friendly graphical user interface, users determine practical targets with ease by interactively adjusting the optimality criteria and fill priorities and then reviewing the resulting classifications. These new targets will vastly improve the ability of the USAF to meet accession needs, exploit the unique skills of its officers, and satisfy officer preferences. This means that officer recruiting dollars will be better utilized as long-term manpower needs are better met. Additionally, job performance

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and retention are likely to improve as more career fields are filled with highly qualified officers and officers are more frequently placed into their desired career fields.

KEYWORDS: Optimization, Officer Classification, Networks, Java

MASTER OF SCIENCE
IN
COMPUTER SCIENCE

SYSTEM EVALUATION OF HARDWARE AND SOFTWARE FOR A STREAMING MULTIMEDIA SERVER USING THE MULTICASTING PROTOCOL

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B.S., Old Dominion University, 1998
Master of Science in Computer Science-September 2003
Advisors: Geoffrey Xie, Department of Computer Science
John Gibson, Department of Computer Science

The next step in the evolution of services provided on an intranet or the internet will be distributed or distance learning with collaboration among peers. Currently, this is done on a one-to-one basis. To expand to a one-to-many collaboration environment, there needs to be a server distributing the multimedia content without creating additional network traffic even though many users are accessing or viewing the multimedia content. Multicasting allows many users to view multimedia content without creating additional network traffic. There is a server providing multimedia content to a multicast address so users may access it. This thesis defines metrics and conducts a comparison of different servers capable of distributing multimedia content using the multicasting protocol.

KEYWORDS: Multicast, Server, Network, Multimedia, Streaming

SECURITY AND EFFICIENCY CONCERNS WITH DISTRIBUTED COLLABORATIVE NETWORKING ENVIRONMENTS

Keith A. Felker-Lieutenant, United States Navy
B.S., University of Illinois at Chicago, 1997
Master of Science in Computer Science-September 2003
Advisors: Geoffrey Xie, Department of Computer Science
John Gibson, Department of Computer Science

The progression of technology is continuous and the technology that drives interpersonal communication is not the exception. Recent technology advancements in the areas of multicast, firewalls, encryption techniques, and bandwidth availability have made the next level of interpersonal communication possible.

This thesis answers why collaborative environments are important in today's online productivity. In doing so, it gives the reader a comprehensive background in distributed collaborative environments, answers how collaborative environments are employed in the Department of Defense and industry, details the effects network security has on multicast protocols, and compares collaborative solutions with a focus on security. The thesis ends by providing a recommendation for collaborative solutions to be utilized by NPS/DoD type networks. Efficient multicast collaboration in the framework of security was a secondary focus of this research. As such, it takes security and firewall concerns into consideration while comparing and contrasting both multicast-based and non-multicast-based collaborative solutions.

KEYWORDS: Security and Efficiency Concerns with Distributed Collaborative Networking Environments, Collaborative Environments in the Department of Defense and Industry, Effects of Network Security on Multicasting, Collaborative Solutions, Collaboration, Multicast, Firewall

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COMPUTER SCIENCE

IMPACT OF THE TELECOMMUNICATIONS ACT OF 1996 AND SPECTRUM ALLOCATION ON CELLULAR TELEPHONE TECHNOLOGY

Jason P. Glowacki-Captain, United States Marine Corps
B.B.A., Eastern Michigan University, 1995
Master of Science in Computer Science-September 2003
Advisor: Bert Lundy, Department of Computer Science
Second Reader: Scott Coté, Department of Computer Science

From 1983, when the first cellular network was established, to 1992, the wireless industry grew by ten million customers. From 1993 to 2000, the wireless industry grew by 90 million customers. Today, there are more than 149 million U.S. wireless subscribers. The phenomenal growth of the wireless industry can be traced to several factors. These factors are improvements in cellular technology, expansion of that technology, and the allocation of spectrum by the federal government.

This thesis analyzes the correlation between the Telecommunications Act of 1996 (the Act) and the rapid expansion of cellular technology that occurred after the Act became law. It also analyzes the impact of spectrum management and allocation on the evolution of cellular technology. To demonstrate how cellular technology has evolved over time, the history, standards, and generations of cellular technology were reviewed. Research findings are shown that validate the Act's impact on the expansion of cellular technology. Finally, the impact of spectrum management and allocation on the evolution of cellular technology in the United States, specifically in terms of implementation of third generation (3G) technology, is shown by analyzing the policies of the government organizations responsible for managing the frequency spectrum.

KEYWORDS: Telecommunications Act of 1996, Cellular Technology, Spectrum Allocation, First Generation, 1G, Second Generation, 2G, Third Generation, 3G

3D BATTLESPACE VISUALIZATION USING OPERATIONAL PLANNING DATA

Claude O. Hutton, Jr.-Captain, United States Marine Corps
B.S., Old Dominion University, 1994
Master of Science in Computer Science-September 2003
Advisors: Don Brutzman, Modeling, Virtual Environments, and Simulation Institute
Curtis L. Blais, Modeling, Virtual Environments, and Simulation Institute

In modern combat operations today, the display of operational data is still tied to stove-piped and proprietary systems and software. Additionally, combat systems are still using 2D displays of the battlefield in order to reflect a picture of the battlefield to the warfighter. Stepping away from stove-piped and proprietary systems and reflecting a 3D picture of the battlefield is the direction that this thesis research explores.

Research is conducted to explore technologies needed to provide operational forces with web-based 3D visualizations of operational data. Technologies used in this research are Extensible Mark-up Language (XML), Extensible Stylesheet Language for Transformation (XSLT), JAVA, Extensible 3D Graphics (X3D), and Virtual Reality Modeling Language (VRML). A prototype application is developed that allows for the 3D display of operational data. The research demonstrates how operational data can be stored in a database and accessed through a web-based 3D representation of the area of operation. Data sets used in this prototype include Digital Terrain Elevation Data and operational planning data. Access to the data is provided through a web-based interface. The web-based view of the data provides both 2D and 3D views. This research shows that current open source technology can provide the warfighter with a web-based 3D view of the battlefield.

KEYWORDS: Virtual Environments, Extensible 3D Graphics, X3D, Extensible Markup Language, XML, Java, Scenario Generation, Combined Operational Picture, COP, Extensible Modeling and Simulation Framework, XMSF, SAVAGE, Database

COMPUTER SCIENCE

MULTI-AGENT SIMULATIONS (MAS) FOR ASSESSING MASSIVE SENSOR COVERAGE AND DEPLOYMENT

Sean E. Hynes-Captain, United States Marine Corps
B.S., University of Florida, 1997
Master of Science in Computer Science-September 2003
Advisor: Neil C. Rowe, Department of Computer Science
Second Readers: Curtis L. Blais, Department of Computer Science
Don Brutzman, Department of Information Science

The thesis presents the design, development, and implementation of a multi-agent simulation that models coverage and deployment of mobile and non-mobile sensors performing collaborative target-detection missions. The focus is on sensor networks with enough sensors that humans cannot individually manage each sensor. Experiments investigate novel search, coverage, and deployment algorithms, and compare them to known methods. The experiments show algorithms productive for area coverage are not useful for detecting unauthorized traversals and vice versa. Obstacles, sensor mechanisms, mission parameters, and deployment schemes are analyzed for their effect on coverage quality. This work facilitates further research in sensor coverage and deployment strategies using sensor agents.

KEYWORDS: Sensor Network, Coverage, Deployment, Exposure, Java, Artificial Intelligence, Agent, Simulation

DYNAMIC CHANNEL ALLOCATION

Andrew D. Kaminsky-Captain, United States Army
B.S., Grand Valley State University, 1993
Master of Science in Computer Science-September 2003
Advisor: John Gibson, Department of Computer Science
Second Reader: Geoffrey Xie, Department of Computer Science

In this thesis, Dynamic Channel Allocation (DCA) offers the possibility of capturing unused channel capacity by allocating unused resources between competing network nodes. This can reduce or possibly eliminate channels sitting idle while information awaits transmission. This holds potential for increasing throughput on bandwidth constrained networks.

The purpose of this thesis is to examine the techniques used to allocate channels on demand and access such methods ability to maximize throughput. This thesis will also explore potential benefits to be gained by DCA through the use of computer simulation.

KEYWORDS: Dynamic Channel Allocation, Fixed Channel Allocation, Inverse Multiplexing

AN OPEN ARCHITECTURE FOR DEFENSE VIRTUAL ENVIRONMENT TRAINING SYSTEMS

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This thesis develops a proposed software system that is usable by programmers to create virtual reality training environment applications for military (or other) use in which characters and character animation are necessary. Such applications are becoming more necessary to fill a gap in military training due to lack of personnel, time, money, and resources. Creation of virtual environment training applications allows military units to augment procedural training in preparation for live or physically simulated training. In the current environment of lesser training and more military requirements, such augmentation will only serve

to benefit unit capabilities. While such systems for developing virtual environment applications are commercially available, those systems are costly in both licensing and usage fees. One of the tenets of the system that this thesis develops is that this system will be free and partially open source, such that programmers can create low cost virtual environment applications for military training, and such that experienced programmers can modify or add to the system in order to improve or enhance its capabilities to meet their needs.

KEYWORDS: Character Animation, Motion Capture, MOUT, Close Quarter Battle, CQBSim, Training, Virtual Environment, Open Source, Scene Graph, Software Architecture

INTEROPERABILITY, DATA CONTROL, AND BATTLESPACE VISUALIZATION USING XML, XSLT AND X3D

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This work represents the realization of Network-Centric goals of interoperability, information management, systems integration, and cohesive battlespace visualization using networked computer technology. The application of structured data methodologies using the Extensible Markup Language (XML) allows organizations and systems to exchange and process battlespace information cooperatively. The practical application of this technology is demonstrated.

Governance of information systems using structured data and the rejection of proprietary, application specific solutions is a leadership responsibility that is defined as Data Control. XML is presented as a leadership control measure that can be used to achieve Network-Centricity on the battlefield.

The fundamental principles of XML application development are presented .in the context of warfighting. Exemplars address a cross-section of battlespace applications. The visualization of the physical battlefield is demonstrated with network delivered 3D terrain views. Geodesy and position reporting is addressed using an XML defined data structure to enforce interoperability. An XML expression of the Battlespace Generic Hub is applied to joint and multilateral interoperability and information exchange. An approach to the effective employment of multiple different, but cooperative, autonomous systems in the battlespace uses XML to define parameters that determine artificial intelligence multi-agent behavior and environmental factors.

This thesis combines a critical analysis of the priorities of Network-Centricity and interoperability with practical and functional exemplars that demonstrate the efficacy of extensible architectures. The pragmatic approach is directed at the warfighter, and leadership challenges are identified.

KEYWORDS: Extensible Markup Language, XML, Extensible 3D Graphics, X3D, Extensible Stylesheet Language for Transformation, XSLT, XML Schema, Interoperability, Battlespace Visualization, Command and Control, Data Control, Digital Terrain Elevation Data, DTED, Geodesy, Position Reporting, Unmanned Aerial Vehicle, UAV, Multi-Agent Systems, Battlespace Generic Hub, Land Command and Control Information Exchange Data Model, LC2IEDM, ATCCIS, Network-Centric Warfare, Java, Extensible Modeling and Simulation Framework, XMSF, MOVES, SAVAGE

A REALISTIC MODEL OF NETWORK SURVIVABILITY

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This thesis focuses on evaluating network survivability and Quality of Service (QoS) in a network. There have been studies on developing network survivability metrics: however, the implementation of these

survivability measures is usually based on unrealistic assumptions. This thesis has some experiment results based on identifying all min-cuts of a network and computing survivability of the nodes based on these criteria.

The main contribution of the thesis is a novel approach to handling correlated or dependent component failures. In a complex network, it is not trivial to compute the probability of failures of the nodes even if the component failures are independent. With this new approach, network administrators could predict the optimal nodes in a network under more realistic conditions. Java-based simulation programs are developed to evaluate the approach. This project is motivated by network security problems in which a decision maker has to select nodes to host critical information servers when there is an attack to the network. The solution will give the decision makers criteria that would help them to make better decisions.

KEYWORDS: Network Survivability, Network Attacks, Max Flow, Min-cut, Probabilistic Networks, Modeling Dependent Nodes, Graph Algorithms, Bayesian

AUTO-CONFIGURATION OF CISCO ROUTERS WITH APPLICATION SOFTWARE
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The context of this research is to facilitate the control of routers with the Server and Agent based Active Network Management (SAAM), to optimize allocation of network resources, and to satisfy user Quality of Service (QoS) requirements. The SAAM network determines the Quality of Service parameters based on current network conditions and user requirements. These parameters are dynamic, so they must be uploaded into the Cisco routers to take effect. The focus is on determining the most efficient way of communicating between the Cisco routers and the SAAM system. This is accomplished by several key components of the proxy-based solution as the first step for integrating with a legacy network.

This thesis develops methods and application software to automatically update the configurations of Cisco routers based on the current network condition. These methods are required by any solution that resolves to upgrade the existing legacy network to provide QoS without expensive equipment replacement. As a result, users are provided with a network they can expect to function properly.

KEYWORDS: Cisco, IOS, Console, Ethernet, Telnet, SSH, QoS, Perl, Socket, HyperACCESS, API, HAPI, Visual Basic, C++

AN EVALUATION OF THE NETWORK EFFICIENCY REQUIRED IN ORDER TO SUPPORT MULTICAST AND SYNCHRONOUS DISTRIBUTED LEARNING NETWORK TRAFFIC
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The United States military has had, and will continue to have, a legacy of comparatively short tours and long deployments in locations where the availability of all forms of education and training may be limited. This not only limits the potential of military members but can have a detrimental effect on morale and retention. Distributed Learning is one way to combat this ever increasing dilemma.

With the proliferation of computer technology and Internet access throughout the Department of Defense (DoD), Distributed Learning can put education and training at the finger tips of most military members. It can even bring education to the field, limited only by the networks, data delivery methods, and bandwidth provided military units.

This thesis examines the network requirements needed to provide a good quality of service (QoS) to sailors and soldiers, and provides guidelines for implementing Distributed Learning over multicast on DoD networks. Multicast is a very efficient method of delivering data to multiple recipients, and is the

underlying technology which can allow interactive Distributed Learning. It is therefore the primary focus of this thesis.

KEYWORDS: Multicast, Multicasting, Distributed Learning, Network, Protocol, PIM, DVMRP, IGMP, SAP/SDP, IGMP Snooping, Dense Mode, Sparse Mode

SECURE GROUND-BASED REMOTE RECORDING AND ARCHIVING OF AIRCRAFT "BLACK BOX" DATA

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Aircraft accident investigation centers upon the analysis of all available information about the accident flight in the period leading up to the final catastrophe. Key among the sources of information is data captured and recorded in the flight data recorder and cockpit voice recorder, which are often referred to as the aircraft "black boxes." For some accidents, this flight data may be lost entirely or partially damaged and largely unusable. The aircraft flight data recorders are the only place where flight data is recorded. This single recording point is a vulnerability to the availability of flight data that can be addressed by creating another place where the data is stored. This thesis examines the feasibility of, and discusses the technical framework necessary for, a system that transmits flight data from an aircraft to a ground recording station. The focus will be upon the requirements for security and assurance of the information flow, so that the confidentiality, integrity, availability, and authenticity of the data are ensured.

KEYWORDS: Black Box, Aircraft Flight Data

MANPOWER REQUIREMENTS DATABASE FOR THE GREEK NAVY

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The Greek Navy is trying to create a Web-enabled Database system, which will enhance and facilitate the process of assigning duties (jobs) to its officers.

This study provides a prototype for implementing the job-to-officers assignment process by creating a manpower Database accessed via the Internet. This prototype is based on the 3-tier architecture, having both the Web and Database design and implementation. Behind the scenes is a multi-criteria decision algorithm that takes the officers' credentials and the officers' and commands' preferences into account and then determines the best distribution of the officers to the available jobs. '

This thesis and the supporting research will strive to develop the requirements and a working prototype web site for the detailer, and reduce both manpower and time required to complete the assignment process conducted by the Greek Navy's Department of Personnel.

KEYWORDS: Web-enabled Database, Relational Database, Manpower Systems, Three-tier Application, Multi-criteria Decision Problem, Algorithm, Greek Navy, Officer, Command, Credentials, Qualifications, Officer's Preference, Command's Preference

AN OPEN-SOURCE AND JAVA-TECHNOLOGIES APPROACH TO WEB APPLICATIONS

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Web applications have become a critical component of the global information infrastructure. In government organizations, proprietary software is currently being replaced by open-source. This thesis explores using open-source and Java technologies to implement Web applications. A prototype of the framework was implemented for a military information site. Implementation was straightforward and performance of the prototype was excellent, demonstrating advantages in terms of reliability, portability, maintainability, and economy.

KEYWORDS: Web Application, Open-source Software, Java Servlets, Java Server Pages, JSPs, Linux, Web Server, Structured Query Language, SQL, Java Database Connectivity, JDBC

THE ARTILLERY FIRE DIRECTION CENTER SIMULATION

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In recent years, declining budgets, limitations on artillery ammunition, and decreases in training areas have reduced the opportunity to conduct live fire artillery training. For these reasons, simulation systems are available for providing an almost realistic training platform for the forward observer. One of them is "The Forward Observer Personal Computer Simulator (FOPCSIM)," which is the thesis work of two students, David Brannon and Michael Villandre. FOPCSIM is a useful tool for the training of the forward observer without major requirements. However, it is a stand-alone system and many of the actual procedures of the observed fire are provided by the system. This thesis presents another system, which simulates the Fire Direction Center procedures during a firing mission. The two systems have a network communication for exchanging messages, similar to the real communication messages between the forward observer and the FDC. Now, the training of the forward observer is more realistic because this person must take into account the existence of the FDC, must wait for responses for each message sent out, and must deal with problems such as communication errors, time delays in sending and receiving messages, and modifications in the call for fire from the FDC. The new system will provide feedback by keeping a history of each mission and giving the observer the capability to review the process of each mission and make useful conclusions about performance.

KEYWORDS: Field Artillery, Fire Direction Center, Forward Observer, Call for Fire, FDC, FOPCSIM, Training, Virtual Environment, Fire Support, Simulation

ANALYSIS OF VOICE QUALITY PROBLEMS OF VOICE OVER INTERNET PROTOCOL (VOIP)

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After its introduction in mid 1990s, Voice over Internet Protocol (VoIP), or IP telephony, has drawn much attention. The prospect of cost savings on long distance and international toll calls, the global presence of Internet Protocol (IP), and the trend to converge data networks with voice networks have made VoIP one of

the fastest growing telecom sectors. Additionally, the emergence of 3rd Generation (3G) cellular technology which offers high bandwidth will result in the convergence of the Internet and the cellular networks, which will further stimulate the growth of VoIP. However, VoIP faces many problems, mainly because of the nature of IP networks which were built to transport non-real-time data, unlike voice.

This thesis analyzes factors affecting the voice quality of VoIP. These factors are delay, jitter, packet loss, link errors, echo, and Voice Activity Detection (VAD). Further, implementation suggestions to lessen the effects of these factors are presented and finally, these suggestions are analyzed.

KEYWORDS: Voice Over Internet Protocol, VoIP, IP Telephony, Internet Telephony, H.323, Voice Quality

FULL-DUPLEX UNDERWATER NETWORKING
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John Gibson, Department of Computer Science

This thesis focuses on developing a full-duplex underwater acoustic network and in developing a new protocol utilizing Demand Assigned Multiple Access (DAMA) and frequency division multiple access code (FDMA). This new protocol will be utilized to expand networking capabilities in an underwater environment. Benefits of advancements in this area include fiscal savings and optimization of bandwidth usage creating an increased rate of data transfer.

The research conducted in establishing a full-duplex UAN using FDMA will put the Naval Postgraduate School at the forefront of UAN technology, and make a significant contribution to understanding underwater networking, the benefits of full-duplex underwater networking, and full-duplex underwater networking using DAMA. These solutions will increase the efficiency and reliability of underwater data transfer and in turn, could be used for further research or as a stepping stone towards improved monitoring of oceanographic anomalies and littoral waters.

KEYWORDS: Half-duplex, Full-duplex, DAMA, FDMA, OMNeT++, Temperature, Salinity, Pressure, Noise Interference

MASTER OF SCIENCE
IN
CONTRACT MANAGEMENT

PERFORMANCE-BASED SERVICE ACQUISITION (PBSA) OF TRIDENT STRATEGIC WEAPONS SYSTEMS (SWS) TECHNICAL ENGINEERING SUPPORT (TES) SERVICES
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David Krueger, Strategic Systems Programs

The objective of this thesis is to determine whether the Strategic Systems Programs (SSP) should apply the concepts of Performance Based Service Acquisition (PBSA) to Strategic Weapons Systems (SWS) Technical Engineering Support (TES) Services. This thesis provides a Department of Defense (DoD), Department of the Navy (DON), and SSP SWS program acquisition and PBSA history background, reviews overarching PBSA policy and the DON PBSA implementation plan, defines a working PBSA model, defines Major Defense Acquisition Programs (MDAPs), details the SWS program structure, defines target SWS TES services, and reviews and analyzes SWS TES service contracts and associated PBSA implementation attempts. The thesis concludes that the complete conversion of SWS TES services to PBSA is neither practicable nor desirable and recommends that SSP: (1) establish a Government-only multi-functional PBSA team to perform a review of existing TES services statements of work to determine potential PBSA conversion tasking, (2) team with its business partners to develop a PBSA conversion business case, and (3) contract for selected SWS PBSA TES services through the use of a CPIF completion contracting approach with an aggressive share line and targeted performance incentives.

KEYWORDS: Performance-based Service Acquisition, PBSA, Strategic Weapons Systems, SWS, Technical Engineering Support, TES, Services, PBSA Policy, Department of the Navy, DON, PBSA Implementation Plan, Major Defense Acquisition Programs

MASTER OF SCIENCE
IN
ELECTRICAL ENGINEERING

PERFORMANCE EVALUATION OF THE AN/USQ-146 JAMMER OVER UNCODED SLOW FH/MFSK MILITARY COMMUNICATION SYSTEMS AND THE IEEE 802.11A WIRELESS LAN COMMERCIAL COMMUNICATION STANDARD

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On the modern battlefield communication is critical. Individual units require a steady flow of accurate information between headquarters and field units to remain effective. Just as important, denying the enemy the same needs of communicating with the help of electronic countermeasures (ECM), is essential to success. Communications jamming and surveillance are critical to achieve information superiority. This thesis evaluates the performance and capabilities of one of the most advanced devices that detects, analyzes, and denies enemy signals: the Rockwell Colins AN/USQ-146 transportable communication jammer. The jammer's best strategy varies with respect to the modulation technique that the hostile communication system uses. As the theoretical analysis and the simulation results indicated, the AN/USQ-146 jammer achieves its best performance over a FH/MFSK system when it selects the repeat multitone jamming strategy. However, when the hostile communication system is the IEEE 802.11a wireless local area network (WLAN) system, the AN/USQ-146 (Rubicon II) jammer must select the partial-band jamming strategy with $p = 0.1$. The results of the theoretical analysis and the simulation modeling of the specific jammer for all types of jamming in manual spot and repeat modes over FH/MFSK military communication systems and new advanced wireless standards, such as the IEEE 802.11a, can be used as guidelines to select the most effective jamming strategy for the specific type of hostile waveform encountered.

KEYWORDS: Battlefield Communication, Electronic Countermeasures, AN/USQ-146 Transportable Communication Jammer, Jamming Strategy

DESIGN, CONSTRUCTION, AND TESTING OF A HYSTERESIS CONTROLLED INVERTER FOR PARALLELING

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The U.S. Navy is pursuing an all electric ship that will require enormous amounts of power for applications such as electric propulsion. Reliability and redundancy in the electronics are imperative, since failure of a critical system could leave a ship stranded and vulnerable. A parallel inverter drive topology has been proposed to provide reliability and redundancy through load sharing. The parallel architecture enables some functionality in the event that one of the inverters fails. This thesis explores paralleling current-mode inverters of different power levels and fidelities. A 50 kVA, three-phase hysteresis controlled inverter is designed, built, and tested at low power. The inverter is then tested in parallel with a low frequency, bulk inverter to demonstrate current sharing capability.

KEYWORDS: Hysteresis Control, Inverter, Parallel Inverters, Load Sharing

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LEAST SQUARES AND ADAPTIVE MULTIRATE FILTERING

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This thesis addresses the problem of estimating a random process from two observed signals sampled at different rates. The case where the low–rate observation has a higher signal–to–noise ratio than the high–rate observation is addressed. Both adaptive and non–adaptive filtering techniques are explored. For the non–adaptive case, a multirate version of the Wiener–Hopf optimal filter is used for estimation. Three forms of the filter are described. It is shown that using both observations with this filter achieves a lower mean–squared error than using either sequence alone. Furthermore, the amount of training data to solve for the filter weights is comparable to that needed when using either sequence alone. For the adaptive case, a multirate version of the LMS adaptive algorithm is developed. Both narrowband and broadband interference are removed using the algorithm in an adaptive noise cancellation scheme. The ability to remove interference at the high rate using observations taken at the low rate without the high–rate observations is demonstrated.

KEYWORDS: Multirate Filtering, Adaptive Filtering, Multirate Adaptive Filter, Multirate Optimal Filter, Least Squares Filtering

RADIATION DOSE ANALYSIS OF NPS FLASH X-RAY FACILITY USING SILICON PIN DIODES

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Radiation output of the NPS Flash X-ray facility has been analyzed using commercial silicon PIN diodes. These results have been compared to dosimetry techniques using CaF2 TLDs (thermoluminescent dosimeters). The silicon PIN diodes were irradiated up with photon energies of approximately 1 MeV and dose rates up to 1010 rad(Si)/s. These techniques and results can be used to provide real time calibration of the Flash X-ray facility.

KEYWORDS: Silicon Radiation Detectors, Flash X-ray, Dosimetry, Thermoluminescent Dosimeters

PHYSICALLY BASED MODELING AND SIMULATION OF A SHIP IN OPEN WATER 3-D VIRTUAL ENVIRONMENT

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This thesis addresses the development of a physically based modeling simulator for a ship in a 3-D virtual environment to be used in naval tactical training systems. The objective is to develop a computer simulation program in which physical models are implemented in order to achieve a realistic representation of a ship in a virtual environment, considering its physical features in the presence of environment conditions including waves, ocean current, wind, fog, and day/night issues. The simulator was developed by integrating five marine models with a virtual ocean environment created with a visual simulation builder tool. The marine models include a maneuvering model, a wave model, a wind model, and an ocean current

model. The numerical results from another complex wave model were also combined using linear interpolation to increase the realism level of the simulator. The result of this thesis shows that the integration of multiple models from different sources is a feasible approach to meet the application requirements. The result also indicates that the use of the interpolation technique to take advantage of complex models yields a simulator with an acceptable level of realism while imposing very low computational load in the application program.

KEYWORDS: Physically Based Modeling, 3-D Virtual Environment, Ship Maneuvering Simulator, Environment Disturbances

NETWORK-BASED CONTROL, MONITORING AND CALIBRATION OF SHIPBOARD SENSORS

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The objective of this thesis is to develop a new calibration system for analog and smart digital pressure sensors, operable by only one person, and capable of calibrating local and remote sensors connected via RS232 cables, Bluetooth, or an 802.11b wireless LAN. It is proposed that the operator uses a portable calibration standard and a tablet PC to conduct the sensor calibration. In order to handle local sensors directly connected to the tablet PC and remote sensors connected to the tablet PC via a network capable application processor (NCAP), a dual module application is proposed and developed using LabVIEW. The application has a Master Module and a Slave Module. Both modules are able to connect to multiple digital sensors at the same time. The Master Module was designed to run on the operator's tablet PC offering an easy-to-use Graphical User Interface (GUI) that allows the monitoring or calibration of any connected sensors. The Slave Module was designed to run on any networked PC, including the operator's tablet and an NCAP. A dedicated Virtual Instrument (VI) was designed for an iterative calibration process based on a least squares fitting method. This VI automatically computes the calibration constants that minimize the measurements errors, and writes the calibration constants to the sensor's RAM or EEPROM. A prototype shipboard sensor test bed was constructed in the laboratory, which consists of a Honeywell PPT digital pressure sensor, an Omega analog pressure sensor, and other 802.11b and Bluetooth wireless LAN components. The newly developed calibration system was successfully demonstrated.

KEYWORDS: Network-based Calibration, Wireless LAN, Bluetooth, Datasocket, Labview, Smart Sensors, Pressure Sensors

DESIGN AND OPTIMIZATION OF A 600 KJ RAILGUN POWER SUPPLY

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The purpose of this thesis is to explore the design options for a 1.2-m railgun power supply capable of accelerating a 150-g to 250-g projectile to 1000 m/s. In order to accomplish this task a MATLAB model will be constructed to conduct trade-off studies between various power supply configurations in an attempt to maximize the system performance. The final design shows that by distributing the system capacitance between four equal size banks and firing them sequentially, the total system capacitance can be reduced by more than half. Because the capacitor banks are fired sequentially, the current pulse is lengthened resulting in more efficient use of the barrel. The final benefit of using a multiple-bank system is that the individual bank currents are reduced by a factor of four over the single-bank scenario. By reducing the bank currents, solid-state switches are now an affordable option further improving the system performance. By applying a

systematic approach to optimizing the power supply, this study has shown that the energy required to accelerate a 172-g projectile to 1000 m/s can be reduced from 1.3 MJ in the single-bank scenario to 600 KJ by distributing the capacitance over four equal sized banks.

KEYWORDS: Railgun, Solid-state Switches, Pulsed Power Supply, Electromagnetic Launch, Thyristors, Spark-gap Switches, Naval Railgun

COST BENEFIT ANALYSIS OF ADJUSTABLE SPEED DRIVES ABOARD ARLEIGH BURKE CLASS DESTROYER
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John Ciezki, United States Naval Academy
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As the U.S. Navy seeks new and innovative ways to maximize its return from a finite budget, an evaluation of its operational practices must be done. Electrical power consumption and fuel efficiency are major factors in the Total Operating Cost (TOC) of naval ships and systems. An evaluation of an alternative means for delivering electrical power to motors and pumps was conducted with the understanding that principles of the findings could be applied to fans as well. Adjustable Speed Drives (ASD) AC induction motors, AC synchronous motors, centrifugal pumps, and positive displacement pumps were examined. The technical challenges associated with ASDs were explored. MATLAB was used to calculate the potential power savings to be gained by introducing ASD technology to the Firemain and Chilled Water Systems. MATLAB was also used to calculate fuel cost savings from reduced consumption of Shipboard power.

KEYWORDS: Adjustable Speed Drive, Pulsewidth Modulation, Affinity Laws, AC Induction Motor, Insulated Gate Bipolar Transistor

SOFTWARE DEFINED RADIO DATALINK IMPLEMENTATION USING PC-TYPE COMPUTERS
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Master of Science in Systems Engineering-September 2003
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Curtis Schleher, Department of Information Science

The objective of this thesis was to examine the feasibility of implementation and the performance of a Software Defined Radio datalink, using a common PC type host computer and a high level programming language. Dedicated transceivers were used, plugged on the PCI bus of host PCs running Windows 2000. Most of the functionality was programmed using the Microsoft Visual C++ language. The tasks to be performed included the channels configuration (number of active channels, center frequencies, sampling and data rates, choice of the appropriate up and down conversion filters), the management of the data transfer between the host computer and the transceiver, the baseband data modulation and demodulation, and the data organization into packets with appropriate headers in order to achieve phase and time synchronization solely by software. A part of the transceivers' configuration was achieved using a configuration utility running in Excel, provided by the manufacturer. Several combinations of M-PSK modulation schemes, channel numbers and datarates were tested in order to measure the performance limits of the system and its ability to perform the required tasks in real-time. The received data streams were further analyzed with the use of Matlab in order to verify the proper functionality of the communication scheme.

KEYWORDS: Software Defined Radio, Communications, Datalink, WaveRunner

MASTER OF SCIENCE
IN
ENGINEERING ACOUSTICS

MODEL-DATA COMPARISON OF SHALLOW WATER ACOUSTIC REVERBERATION IN THE EAST CHINA SEA

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In this thesis, the Monterey-Miami Parabolic Equation (MMPE) model is used to generate predictions from numerical analysis of the reverberation loss structure and peak vertical correlation structure generated by the water/bottom interface, the bottom/sub-bottom interface, and the bottom volume for a shallow water environment. These predictions are then compared to the peak vertical correlation analysis of recorded data collected in an actual shallow water environment similar to the modeled environment. This experimental data was recorded by a 32-element vertical line array (VLA) that recorded the reverberant return generated by charges detonated over the continental shelf in the East China Sea as part of ASIAEX. A comparison is made between predictions and recorded data by analyzing trends in peak vertical correlation with decreasing bandwidth. The influences of interface roughness, bottom volume perturbations, and water volume turbulence on peak vertical correlation is also determined.

KEYWORDS: Shallow Water Reverberation, Reverberation Pressure Levels, Coherence, Peak Vertical Correlations, East China Sea, MMPE

DEVELOPMENT OF FOUR-ELEMENT END-FIRE ARRAY AS SEISMO-ACOUSTIC SONAR SOURCE

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The goal of the research described in this thesis was to design and develop a four-element end-fire array to be used as a seismo-acoustic SONAR source to preferentially excite Rayleigh waves. A four-element end-fire array, consisting of four vertical-motion inertial mass shakers spaced 25 cm apart (approximately one-quarter wavelength), was deployed on the sand in the near-surf zone of Del Monte Beach. The beam of the array was directed to end-fire by using a delay/pulse generator to individually trigger four function generators. Testing at the beach was conducted and results have shown nice end-fire beam patterns at a radius of 3.5 meters, with approximately 15 dB suppression to the rear of the array relative to the forward direction.

KEYWORDS: Seismic SONAR, Seismo-acoustic, Landmine Detection, Seismic Waves, End-fire Array

MASTER OF SCIENCE
IN
ENGINEERING SCIENCE

CLASSIFICATION AND ANALYSIS OF LOW PROBABILITY OF INTERCEPT RADAR SIGNALS USING IMAGE PROCESSING

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The characteristic of low probability of intercept (LPI) radar makes it difficult to intercept with conventional signal intelligence methods, so new interception methods need to be developed. This thesis initially describes a simulation of a polytime phase–coded LPI signal. The thesis then introduces a method for classification of LPI radar signals. The method utilizes a parallel tree structure with three separate "branches" to exploit the image representation formed by three separate detection methods. Each detection method output is pre–processed and features are extracted using image processing. After processing the images, they are each fed into three separate neural networks to be classified. The classification output of each neural network is then combined and fed into a fourth neural network performing the final classification. The outcome of testing shows only 53%, which might be the result of the image representation of the detection methods not being distinct enough, the pre-processing/feature extraction not being able to extract relevant information, or the neural networks not being properly trained. The thesis concludes with a brief discussion about a suitable method for image processing to extract significant parameters from a LPI signal.

KEYWORDS: Signal Processing, Image Processing, LPI, LPI Radar Signals, Classification

MASTER OF SCIENCE
IN
INFORMATION SYSTEMS AND OPERATIONS

MANPOWER REQUIREMENTS DATABASE FOR THE GREEK NAVY
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The Greek Navy is trying to create a Web-enabled Database system, which will enhance and facilitate the process of assigning duties (jobs) to its officers.

This study provides a prototype for implementing the job-to-officers assignment process by creating a manpower Database accessed via the Internet. This prototype is based on the 3-tier architecture, having both the Web and Database design and implementation. Behind the scenes is a multi-criteria decision algorithm that takes the officers' credentials and the officers' and commands' preferences into account and then determines the best distribution of the officers to the available jobs.

This thesis and the supporting research will strive to develop the requirements and a working prototype web site for the detailer, and reduce both manpower and time required to complete the assignment process conducted by the Greek Navy's Department of Personnel.

KEYWORDS: Web-enabled Database, Relational Database, Manpower Systems, Three-tier Application, Multi-criteria Decision Problem, Agorithm, Greek Navy, Officer, Command, Credentials, Qualifications, Officer's Preference, Command's Preference

MASTER OF SCIENCE
IN
INFORMATION TECHNOLOGY MANAGEMENT

ASSESSING THE POTENTIAL VALUE OF SEMANTIC WEB TECHNOLOGIES IN SUPPORT OF MILITARY OPERATIONS
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Recent military operations have redefined the way modern warfare is waged. In a deliberate effort to achieve and retain information dominance and decision superiority, many innovative technologies have emerged to assist the human warfighter. Unquestionably, these technologies have generated resounding successes on the battlefield, the likes of which have never been seen. With all the success, however, there are still areas for improvement, as the potential exists for further reducing already short sensor-to-shooter times.

The current World Wide Web (WWW) is largely a human-centric information space where humans exchange and interpret data. The Semantic Web (SWEB) is not a separate Web, but an extension of the current one in which content is given well-defined meaning, better enabling computers and people to work in cooperation. The result is the availability of the various backgrounds, experiences, and abilities of the contributing communities through the self-describing content populating the SWEB. This thesis assesses current SWEB technologies that promise to make disparate data sources machine interpretable for use in the construction of actionable knowledge with the intent of further reducing sensor to shooter times.

The adoption of the SWEB will quietly be realized and soon machines will prove to be of greater value to war fighting. When machines are able to interpret and process content before human interaction and analysis begins, their value will be further realized. This off-loading, or delegation, will produce faster sensor-to-shooter times and assist in achieving the speed required to achieve victory on any battlefield.

KEYWORDS: Semantic Web, XML, OWL, DAML, RDF, Knowledge Base, Database, Jini, Java, Agents, Ontologies, CoABS, Data Sources, Knowledge Generation, Jess

BUSINESS PROCESS REENGINEERING WITH KNOWLEDGE VALUE ADDED IN SUPPORT OF THE DEPARTMENT OF THE NAVY CHIEF INFORMATION OFFICER
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As the Department of Defense (DoD) begins transitioning to face the new global threats of terrorism, the new requirements of a refocused National Strategy will inherently force the DoD to transform its processes in support of the new National Strategy. In the next few years, the technology used to support the DoD will

continue to grow with the new demands, thus, the DoD will have achieved transformation at all levels enterprise-wide. "Transformation" or radical change has been occurring successfully in the corporate business world for over 25 years, and through this transformation the e-business technology has created an exponential growth in the knowledge producing information exchange systems. As the DoD looks to the e-business world for methodologies and solutions to capture this knowledge and manage it, it must also look for a surrogate definition of value or revenue that can be used as a measurement of return on the knowledge. This thesis will seek to define this value by presenting the e-business methodologies called Return on Knowledge (ROK), Knowledge Value Analysis (KVA), and Business Process Reengineering (BPR) by developing a web-enabled environment called the Transformation Information Technology Enabler (TITE) as a DoD transformation solution.

KEYWORDS: Transformation, Knowledge Value Added, KVA, Return on Knowledge, ROK, Business Process Reengineering, BPR, Information Technology Enabler, ITE, Transformation Information Technology Enabler, TITE

CORRELATION BETWEEN QUALITY MANAGEMENT METRIC AND PEOPLE CAPABILITY MATURITY MODEL
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The quality of software management in a development project is a major factor in determining the success of a project. The four main areas in which a software project manager can affect the outcome of a project are people management, requirements management, estimation/planning management, and risk management. People management is the management area with the highest influence on project success.

In this thesis, a quality management metric (QMM) was evaluated with respect to its conformance with an established people capability maturity model (P-CMM). The survey elements of the QMM were mapped to the processes described in the maturity model. The analysis indicates a high level of conformance of the QMM with the P-CMM. The results of applying the QMM can be used to characterize the quality of software management. Based on the correlation of QMM survey elements to processes of the maturity model, the results can then be used to identify processes that need improvement to increase the likelihood of program success.

Future work includes further refining and assessing the QMM. As new models in the field of software development management evolve, the QMM will need to be re-evaluated with respect to these new models.

KEYWORDS: Software Management, People Management, Quality Management Metric, QMM, People Capability Maturity Model

AN OPTIMIZATION OF THE BASIC SCHOOL MILITARY OCCUPATIONAL SKILL ASSIGNMENT PROCESS
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The reduction of attrition in the junior officer ranks has presented a constant challenge to manpower planners. The desire of an officer to remain on active duty is influenced by his or her satisfaction with their

military occupational skill. The assignment of MOS's to Marine lieutenants has essentially remained unchanged for the past 30 years.

This thesis presents an interdisciplinary solution to the problem of assigning Military Occupational Skills to lieutenants at The Basic School. The thesis captures the requirements analysis, testing, implementation, operation, and maintenance of two-tier decision support system architecture. This thesis presents an alternative business process centered on "MyMOS." MyMOS is a web-based decision support system for use by the lieutenants and staff of The Basic School. This thesis incorporates the use of commercial-off-the-shelf linear programming tools to present and compare an alternative to the existing heuristic assignment methods. The results of this research found that by utilizing optimization techniques, the number of lieutenants who did not receive one of their first five choices could be decreased by an average of 66% and the average choice number assigned could be reduced from 2.9 to 2.1. The incorporation of e-commerce technology increased the return on knowledge associated with the MOS education process and presented the lieutenants with a consistent and familiar interface.

KEYWORDS: Optimization, Linear Programming, Database, Web Enabled, Internet, MOS, Marine Corps

AN ANALYSIS OF IMPLEMENTATION ISSUES FOR THE SEARCHABLE CONTENT OBJECT REFERENCE MODEL (SCORM) IN NAVY EDUCATION AND TRAINING

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The thesis research examines the emergence of Sharable Content Object Reference Model (SCORM) architecture currently under development by the Advanced Distributed Learning (ADL) initiative established by the Department of Defense (DoD). SCORM is a collection of specifications adapted from multiple sources to provide a comprehensive suite of E-learning capabilities that enable interoperability, accessibility, and reusability of Web-based learning content. To better understand the implementation issues of SCORM architecture, the authors analyze all versions of SCORM to understand the evolution of this emerging architecture. It contrasts the evolving requirements for shareable content objects with concerns of copyright issues. The authors address development and implementation issues surrounding the maturation of SCORM architecture and the ADL initiative. The authors recommend that DoD, international, and civilian business partners join in improving E-learning by embracing technology such as SCORM, which allows for shareable content objects to be used and reused within civilian and military education and training Learning Management Systems (LMS) across the World Wide Web.

KEYWORDS: Sharable Content Object Reference Model, SCORM, Advanced Distributed Learning Initiative, ADL, Distance Learning, E-learning

A DECISION SUPPORT SYSTEM FOR THE OPTIMAL DESIGN OF BASE-MOTION ISOLATORS

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Transient analysis of large structural systems is a computationally demanding process, which in the past has prevented dynamic redesign and optimization. Large structures, such as buildings or ships, subjected to random base motions use isolators to minimize strain energies, which may cause damage or structural failure. This research focuses on the optimization of isolator parameters in order for structural systems to withstand potentially catastrophic transient vibrations. Many non-linear hysteretic, viscoelastic, and sliding friction isolators were numerically modeled using the scientific programming language, MATLAB. The existing programs used to solve the Voltera integral formulation for Transient Structural Synthesis (TSS) and the Recursive Block-by-Block (RBB) algorithm were investigated and enhanced to yield greater accuracy and increased computational speed. The final product is a user-friendly Decision Support System (DSS) for use with both civil and military applications. Based on different types of base motions and the inherent dynamics of the structure, this Decision Support System (DSS) is capable of optimizing isolator parameters to meet a user specific objective.

THE SECURITY ASPECTS OF WIRELESS LOCAL AREA NETWORK (WLAN)

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Wireless Local Area Networks (WLAN) are increasing in number in both home and business uses due to the convenience, mobility, and affordable prices for wireless devices. Wireless technology allows the mobile stations to freely move within the range of Access Points without being physically connected to the wired network. Ideally, the WLAN gives mobility and flexibility to users in homes and hot spot environments, such as airports and campuses.

However, WLANs have serious security problems because the wireless signal of the WLAN is broadcast through the air in all directions simultaneously. An unauthorized user can easily capture this signal using freeware tools to exploit WLAN vulnerability.

This thesis provides an introduction to WLAN technology, security vulnerabilities in the WLAN, and the recommended countermeasures for the Software Metrics Laboratory at the Naval Postgraduate School, with particular emphasis on security concerns for the implementation of the WLAN extension to the existing wired LAN.

INFORMATION TECHNOLOGY MANAGEMENT

A REALISTIC MODEL OF NETWORK SURVIVABILITY

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This thesis focuses on evaluating network survivability and Quality of Service (QoS) in a network. There have been studies on developing network survivability metrics: however, the implementation of these survivability measures is usually based on unrealistic assumptions. This thesis has some experiment results based on identifying all min-cuts of a network and computing survivability of the nodes based on these criteria.

The main contribution of the thesis is a novel approach to handling correlated or dependent component failures. In a complex network, it is not trivial to compute the probability of failures of the nodes even if the component failures are independent. With this new approach, network administrators could predict the optimal nodes in a network under more realistic conditions. Java-based simulation programs are developed to evaluate the approach. This project is motivated by network security problems in which a decision maker has to select nodes to host critical information servers when there is an attack to the network. The solution will give the decision makers criteria that would help them to make better decisions.

KEYWORDS: Network Survivability, Network Attacks, Max Flow, Min-cut, Probabilistic Networks, Modeling Dependent Nodes, Graph Algorithms, Bayesian

INTELLIGENT-AGENT-BASED MANAGEMENT OF HETEROGENOUS NETWORKS FOR THE ARMY ENTERPRISE

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The Army is undergoing a major realignment, in accordance with the Joint Vision 2010/2020 transformation, to establish an enterprise command that is the single authority to operate and manage the Army Enterprise Information Infrastructure (Infostructure). However, there are a number of critical network management issues that the Army will have to overcome before attaining the full capabilities to manage the full spectrum of Army networks at the enterprise level. The Army network environment consists of an excessive number of heterogeneous applications, systems, and network architectures that are incompatible. There are a number of legacy systems and proprietary platforms. Most of the NM architectures in the Army are based on traditional centralized NM approaches such as the Simple Network Management Protocol (SNMP). Although SNMP is the most pervasive protocol, it lacks the scalability, reliability, flexibility, and adaptability necessary to effectively support an enterprise network as large and complex as the Army. Attempting to scale these technologies to this magnitude can be extremely difficult and very costly. This thesis makes the argument that intelligent-agent-based technologies are a leading solution, among the other current technologies, to achieve the Army's enterprise network management goals.

KEYWORDS: Intelligent Agent, SNMP, Enterprise Network Management, CoABS, Army Enterprise Infostructure, Global Information Grid

AN ANALYSIS OF SYNERGIES OF IT-APPLICATIONS AND KNOWLEDGE MANAGEMENT STRATEGIES WITH REGARD TO ORGANIZATIONAL CHANGE

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The increasing complexity of political, regulatory, and technological changes confronting many commercial as well as non-profit organizations has made radical organizational change and adaptation a central research issue. Along with these research issues, a new awareness with regard to organization-internal existing knowledge and the necessity to exploit and mange this knowledge to the benefit of the organization has also arisen.

In an era of forth-coming new advanced information technologies on a nearly day-to-day basis and the increasing awareness and willingness to incorporate knowledge management strategies, organizational leaders and upper management have been increasingly craving a beneficial combination of the latter with their efforts to implement changes successfully within their organizations.

This thesis will analyze various organizational change strategies in order to provide a clearer understanding of the impact/influence of current IT-solutions exploiting existing knowledge within an organization to the benefits of successful organizational change efforts and strategies.

KEYWORDS: Knowledge Management, Organizational Change, Change Strategy, Explicit Knowledge, Tacit Knowledge, IT-application, IT-tools, Three-Ring-Perspective, Questionnaire

A COGNITIVE AND PEDAGOGICAL EVALUATION FRAMEWORK FOR COMPUTER-BASED TRAINING

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This thesis research examines the effectiveness of a newly developed cognitive and pedagogical evaluation framework to assess computer-based instruction. All training programs must have comprehensive evaluation guidelines in place to ensure the quality of instruction from the classroom-training environment to the virtual training environment is not diminished. The application of sound cognitive and pedagogical principles helps ensure that organizational training goals will be met. This research developed a set of practical guidelines, or a template, that should be used to evaluate the cognitive and pedagogical aspects of any given computer delivered course of instruction. This template is used to evaluate the United States Navy's newly developed CD-ROM Surface Warfare Officer (SWO) division officer training course. The SWO division officer course is the basic professional training for junior Ensigns that is now contained on CD-ROM and delivered by personal computer.

KEYWORDS: Computer-based Training, Computer-based Education, Distance Learning, Learning Theory, Multimedia, Instructional Evaluation, Cognitive and Pedagogical Evaluation

DESIGN OF AN EFFECTIVE VISUALIZATION FOR NAVAL CAREER INFORMATION SUMMARY AND EVALUATION

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By using visualization best practices and embedding them in information technology (IT), it is believed that the Department of Defense can improve its ability to display multi-variant information.

The focus of this research is to design a visual information solution, based on best practices for displaying performance data visually, to the Electronic Military Personnel Record System (EMPRS). Ultimately, the goal is to improve the overall effectiveness and objectivity of the Navy's selection board processes by providing a re-engineered, web-based, graphical solution to the visual displays currently in use by selection boards.

The current Navy selection board voting process uses tabular forms displayed across five screens in a small theater-like setting. The forms are displayed very quickly allowing board members very little time to mentally assimilate the quantitative data dispersed over a wide area. In this model, the data is distilled into a single graphical display, thus reducing the cognitive computing requirements of the board members.

The Knowledge Value Added methodology was used to determine the proposal's relative effectiveness and a prototype was developed as a proof of concept. With this study and follow on recommendations, a considerable improvement potential in the Navy's promotion board procedures and outcomes is forseen.

KEYWORDS: Naval Promotion, Visualization, Information System Technology, IST, Information Technology Management, ITM, Knowledge Value Added, KVA, Naval Postgraduate School, NPS, Naval Personnel Command, NPC

INFORMATION OPERATIONS IN STRATEGIC, OPERATIONAL, AND TACTICAL LEVELS OF WAR: A BALANCED SYSTEMATIC APPROACH

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This thesis explores the idea whether a balanced systematic approach is a better way to integrate Information Operations (IO) at different levels of war compared to uncoordinated efforts at each level. Analysis of the role of information in a conflict in the context of information superiority provides the foundation of the thesis. DOD's IO core, supporting, and related capability based approach was used in the analysis of each level of warfare. Strategic, operational, and tactical level IO were analyzed by matching relevant IO capabilities with the IO effects desired at the respective levels. Sample systems were provided for each capability when appropriate. IO efforts in Operation Desert Storm and Operation Allied Force were analyzed. This thesis concluded that a balanced systematic approach to IO through its integration at all three levels of warfare will produce much better results than the uncoordinated cases in order to exploit the integrative effect of IO on the instruments of national power and the military capabilities at different levels of warfare.

KEYWORDS: Information Operations, Information Superiority, Levels of Warfare, Operation Desert Storm, Operation Allied Force

DATA WAREHOUSING AT THE MARINE CORPS INSTITUTE
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This thesis is a case study on the value added of an implementation of a data warehouse at the Marine Corps Institute (MCI). Data Warehousing at an environment such as MCI can solve a myriad of strategic questions. The database which MCI possesses, the Marine Corps Institute Automated Information System (MCIAIS), contains a staggering amount of data, waiting to be mined and turned into knowledge for high-level decision makers. The actual value of the data warehouse to the organization is evaluated using the Knowledge Value Added (KVA) methodology. Many methodologies exist that attempt to measure the value added due to Information Technology. KVA allows the description of all process outputs, including those generated from IT in common units. This allows allocation of revenue to IT in proportion to contributions to process outputs at the sub-corporate level, which MCI is at. This thesis looks at warehouses, ways of measuring the value of IT, MCI's organization and core functionality, its current data environment, the implementation of the warehouse, and the value that is added through that implementation.

KEYWORDS: Knowledge Value Added, KVA, Data Warehouse, Return on IT, Data Mining, Database

THE FEASIBILITY OF WEB-ENABLED DIGITIZED VIDEO IN A LEARNING ENVIRONMENT
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Traditional methods of instruction limit a person's ability to gain required knowledge, yet many advanced technologies are not used. The potential knowledge acquisition is improved when digitally videotaping a course. Streamlining video over the Internet (wireless or hardwire), Digital Versatile Disc (DVD), Video Home System (VHS), and other modes of multi-media delivery, many of which are accomplished with little or no coordination, improve knowledge delivery systems.

The technology and flexibility provided by digitizing a course may be extremely beneficial and cost effective. In addition, if educators use methods of network, customer relations, and knowledge management to implement and to maintain processes, operations tend to run smoothly from start to finish.

Essentially, digitally videotaping a course makes it possible to disseminate lessons to facilities by accessing the Internet and providing that data to organizations with computer hardware and software, or simply store that data for future use. Adopting this method enables the product to be created efficiently and expeditiously. Whether at a university, a government installation, a civilian organization, or on a ship, by employing hardware and software to show digitized video, educators can disseminate courses to enhance the learning process in a timely and fairly inexpensive manner.

KEYWORDS: DVD, VHS, Digital Video, Streamlining Video, Internet, World Wide Web, Web-enabled Digitized Video in a Learning Environment

DRAG OPTIMIZATION OF LIGHT TRUCKS USING COMPUTATIONAL FLUID DYNAMICS

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There are 80 million light trucks on the road today with suboptimal aerodynamic forms. Previous research has found that several miles per gallon can be saved by specifically tailoring truck bodies for reduced aerodynamic drag. Even greater savings can be made if the shape of the trucks is numerically optimized. This could reduce fuel consumption in the United States by billions of gallons per year.

The purpose of this research is to develop and quantify optimal light truck canopy designs using computational fluid dynamics (CFD). Both two-dimensional and three-dimensional models are used to do this. Initially, this research focuses on quantifying and generalizing the effects of traditional automotive aerodynamic accessories, such as canopies and air dams. Once the effects of various form factors are quantified, an optimization of the canopy is performed. This thesis demonstrates a method for drag reduction using CFD and traditional numerical optimization techniques. Lastly, the optimized forms are physically constructed and their effects on fuel economy are compared to the CFD prediction.

KEYWORDS: Shape Optimization, CFD, Drag, Canopy, Air Dam, Light Truck, Miles Per Gallon, MPG, Fuel Efficiency, Fuel Economy

MASTER OF SCIENCE
IN
MANAGEMENT

THE NAVY HUMAN RESOURCE OFFICER COMMUNITY: ASSESSMENT AND ACTION PLAN

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This research examines the Navy Human Resource Officer Community (NHROC) in the context of its formation and present makeup and lays out a plan for its immediate future. A thorough review of civilian human resource management and development as well as current initiatives in Navy Human Resources (HR) was examined. The research introduces concepts associated with virtual communities and Communities of Practice and presents lessons learned from the Information Professional Community's virtual community initiative. A survey of the NHROC was conducted to formulate ideas and analyze concepts important to building a virtual community that instill a learning culture indicative of a Community of Practice. The data makes the case for founding a NHROC virtual workplace continuum to foster knowledge sharing, organizational development through continuous learning, and community effectiveness. It provides concepts for a virtual workplace, reviews social considerations, and outlines resource requirements.

KEYWORDS: Human Resources, Navy Human Resource Officer Community, Virtual Community, Community of Practice, Manpower, Personnel, Training

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MILITARY HOUSING PRIVATIZATION INITIATIVE LESSONS LEARNED PROGRAM: AN ANALYSIS

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The Military Housing Privatization Initiative (MHPI) represents a dramatic revision in the construction and maintenance of military housing. Since its inception in 1996, the number of projects has grown exponentially and the learning process has been continuous and steep. This thesis researches the effectiveness of the methods in place at the Department of Defense and Service levels to document, share, and, above all, learn from past experiences. This analysis reviews the cumulative documented lessons from all Services and compares it to the lessons learned within the first jointly partnered privatization project at the Presidio of Monterey (POM) and Naval Postgraduate School (NPS) in Monterey, California.

This research showed at least six lessons previously documented within the lessons learned system, which were relearned at the POM/NPS project. Given this data, the lessons learned program is a partial success but overall has a positive impact on the MHPI. The current lessons learned program improves each new privatization project, ensuring it does not experience all of the same lessons from previous projects. Only a few lessons seem to slip through the cracks and are repeated even after documentation and distribution.

KEYWORDS: Military Family Housing, Military Housing Privatization Initiative, MHPI, Privatization, Public Private Venture, Residential Communities Initiative, RCI, Lessons Learned

MASTER OF SCIENCE IN MECHANICAL ENGINEERING

OBSTACLE AVOIDANCE CONTROL FOR THE *REMUS* AUTONOMOUS UNDERWATER VEHICLE
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As the Navy continues its development of unmanned underwater vehicles, the need for total autonomous missions grows. Autonomous Underwater Vehicles (AUV) allow for advances in mine warfare, harbor reconnaissance, undersea warfare, and more. Information can be collected from AUVs and downloaded into a ship or battle group's network. As AUVs are developed, it is clear forward-look sonar will be required to be able to detect obstacles in front of its search path. Common obstacles in the littoral environment include reefs and seawalls, which an AUV will need to rise above to pass. This thesis examines the behavior and control system required for an AUV to maneuver over an obstacle in the vertical plane. Hydrodynamic modeling of a *REMUS* vehicle enables a series of equations of motion to be developed to be used in conjunction with a sliding mode controller to control the elevation of the AUV. A two-dimensional, $24°$ vertical scan forward look sonar with a range of 100 m is modeled for obstacle detection. Sonar mappings from geographic range-bearing coordinates are developed for use in MATLAB simulations. The sonar "image" of the vertical obstacle allows for an increasing altitude command that forces the AUV to pass safely over the obstacles at a reasonable rate of ascent and pitch angle. Once the AUV has passed over the obstacle, the vehicle returns to its regular search altitude. This controller is simulated over different types of obstacles.

KEYWORDS: Autonomous, AUV, Obstacle Avoidance, Sliding Mode Controller, Hydrodynamic Coefficients, *REMUS*

MOLECULAR DYNAMIC MODELING AND SIMULATION FOR POLYMERS
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Polymers have been widely used in various engineering applications. For more than a quarter century, the materials have been utilized intensively for the binding materials for composites. The material properties of the binding materials called matrix materials play an important role for the composite material behaviors. As a result, the objective of this study was to understand the mechanical properties of polymers. In particular, the goal was to develop insights as to how a molecular level structure is connected to the bulk properties of materials assuming homogeneity. To this end, molecular dynamics was used to model and simulate the polymeric behaviors. Polymeric chains were modeled using the bead and spring model along with interacting potentials. The study examined the effects of different sizes, densities, and numbers of molecules per chain on the shear moduli of the polymers. Furthermore, some preliminary study was also conducted for metallic particle reinforced polymer composites.

KEYWORDS: Molecular Dynamics, Shear Modulus, Polymers, Metallic Potential, Embedded Atom Method, Lennard Jones Potential

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A DECISION SUPPORT SYSTEM FOR THE OPTIMAL DESIGN OF BASE-MOTION ISOLATORS

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Transient analysis of large structural systems is a computationally demanding process, which in the past has prevented dynamic redesign and optimization. Large structures, such as buildings or ships, subjected to random base motions use isolators to minimize strain energies, which may cause damage or structural failure. This research focuses on the optimization of isolator parameters in order for structural systems to withstand potentially catastrophic transient vibrations. Many non-linear hysteretic, viscoelastic, and sliding friction isolators were numerically modeled using the scientific programming language, MATLAB. The existing programs used to solve the Voltera integral formulation for Transient Structural Synthesis (TSS) and the Recursive Block-by-Block (RBB) algorithm were investigated and enhanced to yield greater accuracy and increased computational speed. The final product is a user-friendly Decision Support System (DSS) for use with both civil and military applications. Based on different types of base motions and the inherent dynamics of the structure, this Decision Support System (DSS) is capable of optimizing isolator parameters to meet a user specific objective.

KEYWORDS: Structural Dynamics, Structural Isolation, Nonlinear Transient Analysis, Structural Synthesis, Decision Support System, Recursive Block-by-block, Convolution, Wen, Hysteresis, Earthquake

PERFORMANCE AND FLOW REGIMES IN PLANE 2-D DIFFUSERS WITH EXIT CHANNELS AT LOW REYNOLDS NUMBERS

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A numerical study on laminar incompressible flows in 2-D straight walled diffusers in the low Reynolds number regime (105-1048) is presented to investigate performance and various flow regimes that might exist. Tail channels are situated downstream the diffusers. Geometries with area ratios AR=1.15 to 5 and non-dimensional lengths of L/W1=1 to 48 are considered. Results are presented in terms of flow regime maps for Reynolds numbers of 105, 210, 314, 420, 629, 1,048 and pressure recovery coefficients maps for Re numbers of 105, 210, 314, 420 and 629. In addition, time resolved simulations of impulsively starting flow are considered at Re=210, 314 for 12 geometries on the flow regime map. Four flow regimes can be distinguished depending on diffuser geometry. With increasing divergence angle the flow goes from attached to symmetrically separated to asymmetrically separated and finally to a non 2-D pattern respectively.

KEYWORDS: Diffusers, Low Reynolds, Diffuser Performance, Diffuser Flow Regime

DRAG OPTIMIZATION OF LIGHT TRUCKS USING COMPUTATIONAL FLUID DYNAMICS

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There are 80 million light trucks on the road today with suboptimal aerodynamic forms. Previous research has found that several miles per gallon can be saved by specifically tailoring truck bodies for reduced aerodynamic drag. Even greater savings can be made if the shape of the trucks is numerically optimized. This could reduce fuel consumption in the United States by billions of gallons per year.

The purpose of this research is to develop and quantify optimal light truck canopy designs using computational fluid dynamics (CFD). Both two-dimensional and three-dimensional models are used to do this. Initially, this research focuses on quantifying and generalizing the effects of traditional automotive aerodynamic accessories, such as canopies and air dams. Once the effects of various form factors are quantified, an optimization of the canopy is performed. This thesis demonstrates a method for drag reduction using CFD and traditional numerical optimization techniques. Lastly, the optimized forms are physically constructed and their effects on fuel economy are compared to the CFD prediction.

KEYWORDS: Shape Optimization, CFD, Drag, Canopy, Air Dam, Light Truck, Miles Per Gallon, MPG, Fuel Efficiency, Fuel Economy

MASTER OF SCIENCE
IN
METEOROLOGY

EVALUATION OF EM PROPAGATION MODELS USING DATA FROM WALLOPS ISLAND EXPERIMENT (2000)
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Second Reader: Wendell A. Nuss, Department of Meteorology

The Royal Navy and the United States Navy emphasize utilizing the environment to achieve a tactical edge. Such approaches are outlined in Sea Power 21. This thesis recognizes accurate characterization of the physical battlespace as vital to concepts of both self-defense (Sea Shield) and strike (Sea Strike). Electromagnetic (EM) propagation is presented as a vital factor in the performance of a wide variety of ship, land, and airborne sensors and weapon systems. Atmospheric influences on EM propagation are related to gradients of temperature and humidity within the atmosphere. It is emphasized that modern maritime warfare is increasingly concentrated in the coastal theatre, an area in which atmospheric variability is often at maxima in both the vertical and horizontal. This thesis examines, using currently available technology and operational methods, how well the physical EM battlespace is described. Propagation models from the U.K. and U.S. are used to evaluate the propagation environment within the coastal zone, using measured data collected from the East Coast of the USA at Wallops Island during 2000, as a comparison. The main findings relate to the large potential errors, due the inability to measure and characterize the variability of the coastal environment under simulated, operational scenarios.

KEYWORDS: EEMS, AREPS, RF Propagation, Refractivity, Coastal Variability, Wallops Island, Surface Ducting and Evaporative Ducting Effects, Operational Simulation

MASTER OF SCIENCE
IN
METEOROLOGY AND PHYSICAL OCEANOGRAPHY

THE CIRCULATION AND VARIABILITY IN THE WESTERN ARCTIC OCEAN-MODEL RESULTS

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Circulation in the western Arctic Ocean is not well understood. To address some of its outstanding questions, volume transport and property fluxes are investigated using a coupled ice-ocean model of the pan-Arctic region configured at a 1/12-degree and 45-level grid. Results for analyses are from the last 23 years of a 70-year integration forced with realistic 1979-2001 atmospheric data. Velocity at three depth intervals, mean transports, and fluxes are investigated to identify the main current pathways and directions. Variability is determined by comparison of results a decade apart.

Mean velocity fields describe a climatological circulation pattern that is cyclonic in nature with increased intensity during the late 1980s and early 1990s. The meander through the Chukchi Borderland Pass is the main pathway for boundary flow across the Chukchi Plateau. The northern Chukchi Plateau is modeled as a region of major volume, heat, and freshwater transport into the Canada Basin interior. It also appears to be an area of net upward heat transport, which may be available for melting ice. Northward flow along the eastern side of the Northwind Ridge is identified as a mechanism for advection of freshwater from the Chukchi shelves into the interior.

KEYWORDS: Arctic Ocean, Oceanography, Modeling

PREDICTABILITY OF JAPAN/EAST SEA (JES) SYSTEM TO UNCERTAIN INITIAL/LATERAL BOUNDARY CONDITIONS AND SURFACE WINDS

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Numerical ocean modeling usually composes various initial- and boundary-value problems. It integrates hydrodynamic and thermodynamic equations numerically with atmospheric forcing and boundary conditions (lateral and vertical) from initial states of temperature, salinity, and velocity. Past observations, historical datasets, and climatological datasets of the ocean have contributed greatly to the knowledge of the data fields of initial condition, atmospheric forcing, and boundary conditions. Change in either initial or boundary condition leads to a variety of model solutions. It is necessary to specify realistic initial and boundary conditions to achieve better understanding and prediction of the ocean behavior. However, uncertainty often exists in both initial and boundary conditions. Up to now, most studies on ocean predictability have usually been for one particular type of model input uncertainty within the three types of uncertainty (initial conditions, open boundary conditions, atmospheric forcing function). This thesis investigates the response of ocean model to the three types of model input uncertainty simultaneously using Princeton Ocean Model (POM) implemented for the Japan/East Sea (JES).

KEYWORDS: Initial Conditions, Wind Forcing, Lateral Boundary Transport, POM, JES

METEOROLOGY AND PHYSICAL OCEANOGRAPHY

AN ESTIMATION OF THE ABILITY TO FORECAST BOUNDARY LAYER MIXING HEIGHT AND WIND PARAMETERS THROUGH FORECAST VERIFICATION OVER FORT ORD

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Conducting controlled burns at Fort Ord requires specific meteorological and operational criteria. A minimum five-mile per hour offshore wind flow in conjunction with a minimum lower vertical mixing height of 1500 feet is meteorologically required. Burn contractor operational constraints require these meteorological parameters to be forecast 72 hours prior to burn. In this thesis, forecast verification percentage baselines for offshore and onshore winds were established. These 24, 48, and 72 hour forecasts were verified by 1200 UTC analyses at 850 mb and profiler observations. The observations were from the surface to 1500 feet. From these baselines the forecast skill when including a second burn prescription parameter, lower vertical mixing height, is inferred. Resulting forecast verification percentages using profiler observations of offshore wind flow were less than 40% at all forecast durations. Results indicate that during the burn season (July through December) the synoptic scale forecasts do not adequately represent the local wind field over Fort Ord. As the burn season progresses, synoptic scale forcing becomes stronger and mesoscale forcing weakens over Fort Ord, favoring forecast verification with profiler observations. Lastly, the inferred forecast skill of both offshore wind flow from the surface to 1500 feet and the minimum vertical lower mixing height simultaneously at all durations is 10%.

KEYWORDS: Forecast Verification, Doppler Wind Profiler Observations, AVN Simulations, Fort Ord, Chemical/Biological Defense

SUBTIDAL CIRCULATION OVER THE UPPER SLOPE TO THE WEST OF MONTEREY BAY, CALIFORNIA

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Moored current meters were used to describe currents over the continental slope off Monterey Bay, California, from March 1998 to March 2003. The water depth at this location was 1800 m and current observations included depths of 16-88 m, 210-290 m, 305 m and 1200 m, although measurements at 16-88 m were not continuous. Poleward currents dominated the flow between 24 and 305 m. At 305 m the mean flow was 3.9 cm/s toward 334°. Surprisingly, at 1200 m the mean flow reversed and was 0.8 cm/s toward 169°. The principal axis for the flow at 305 m (1200 m) was 349° (350°), the semi-major axis was 9.4 cm/s (5.8 cm/s), and the semi-minor axis was 3.4 (2.0 cm/s). The direction of the principal axis and the mean flow at 1200 m was aligned with the bathymetry to the east of the mooring site.

The seasonal cycle at 305 m was dominated by an acceleration of the poleward flow from a minimum near zero on April 15 to maximum, 25 cm/s, on July 15. This flow resulted in an increase of temperature at 305 m of 1.2° C due to geostrophic adjustment and a corresponding 10 cm increase in sea level due to steric effects. The acceleration of alongshore flow was out of phase with the alongshore pressure gradient, which was greatest in mid-April. At 1200 m, the temperature increase (0.2° C) only lasted from April 15 to June 1, after which equatorward flow increased and temperature decreased.

Mesoscale variability dominated the velocity measurements with maximum variance at about 60-day periods. At 305 m, the eddy kinetic energy was greatest (smallest) in October (December), 40 cm²/s² (4 cm²/s²) while at 1200 m the maximum (minimum) occurred in July (February), 5 cm²/s² (0.5 cm²/s²). Poleward events were stronger at 305 m while equatorward events were stronger at 1200 m.

The three first empirical orthogonal functions explained 90% of the temporal variability of the horizontal currents. The first, second, and third Z-score represented flow along the principal axis, undercurrent vs. Davidson current, and upwelling modes, respectively. While the seasonal patterns for the

first two modes agreed with seasonal variability described above, the seasonal variability of the upwelling mode (6% of the variance) indicated that the waters between 16 and 88 m flowed onshore during the spring and summer upwelling period.

KEYWORDS: California Current System, Seasonal and Mesoscale Circulations off Monterey, CA

VISIBILITY OVER LAND FROM CONTRAST ANALYSIS OF MULTI-SPECTRAL SATELLITE OBSERVATIONS

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The objective of this thesis is to investigate the viability of using contrast reduction in multi-spectral satellite observations to characterize surface visibility reduction due to heavy aerosol loading. Two methods are explored. First, the spectral distribution of standard deviation of surface reflectance over a homogeneous background (urban, agriculture, or forested) is plotted for three aerosol conditions (dust, smoke, and low aerosol loading). Second, the same cases are analyzed using a pixel-to-pixel differencing of surface reflectance. The spectral distributions of the means for the resulting difference fields are constructed. Each aerosol type was found to exhibit a relatively unique spectral distribution for both methods. Each background was found to exhibit a characteristic amount of contrast in the absence of heavy aerosol loading. The unique spectral characteristics for each aerosol-background combination may be correlated to aerosol optical depths or surface visibilities with corrections for sensor view angle variations, Rayleigh scattering, and masking of clouds and surface water. The spectral distribution-aerosol optical depth correlation can be used to build an empirical model for aerosol optical depth and surface visibility retrievals from satellite observations. This method may be applied to multi-spectral or panchromatic imagery, unlike current aerosol optical depth retrievals over land.

KEYWORDS: Visibility, Aerosol, Satellite Observations, Aerosol Optical Depth Retrieval, Over Land, Contrast

MASTER OF SCIENCE
IN
MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

REALISTIC EVALUATION OF TERRAIN BY INTELLIGENT NATURAL AGENTS (RETINA)
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Second Reader: John Hiles, Department of Computer Science

U.S. Army and joint constructive simulations require human operators to observe the exercise in progress, conduct analysis of the results, and provide realistic reports and assessment of the action presented on their screens to the desired training audience. Current software tools provide excellent mathematical assessments (such as center of mass calculations, optimal routes, and sensor ranges) but poor human-like assessment of data (most likely route, probable enemy intention, etc.).

This thesis presents an artificial intelligence architecture specifically designed to reduce that manpower requirement by describing a concept for computer modeling that can produce realistic human-like assessment results. Specific concepts described are approaches for conducting a digital terrain assessment, development of avenues of approach, deployment of templated forces to a specific piece of terrain, and a method of adjusting the templated force to react to actual sightings and known information.

Also included are more detailed discussions and implementation details for use of gas diffusion as a method of analyzing avenues of approach through digital terrain. This approach seems quite promising as a method of modeling human movement tendencies and appears superior to classic path finding or optimal route selection methods.

KEYWORDS: Path Finding, Navigation, Computer Vision, Terrain, Intelligence Preparation of the Battlefield, Recognition Primed Decision Model, Agents, Reactive Agents, Assessment, Avenues of Approach, Diffusion, Fluids, DTED, Simulation, Model, Route Selection

TOWARD XML REPRESENTATION OF NSS SIMULATION SCENARIO FOR MISSION SCENARIO EXCHANGE CAPABILITY
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In this thesis, work toward completion of an XML-based Scenario Exchange capability for the Naval Simulation System (NSS) is presented. NSS is a powerful modeling and analysis tool developed by the Navy for use in performing campaign analysis, naval forces studies, and course of action analysis. XML is a World Wide Web specification that allows a designer to develop a new language to structure data, while maintaining a rule-based specification for how to move that data around on the web. XML-based applications can export the contents of internal structures in such a way that another application can easily import the data that is unique to its own input requirements. Research conducted in this thesis produced an XML representation of the NSS Simulation Scenario, along with its validating schema. This pair of documents form the core of the NSS XML-based Scenario Exchange capability. Future work to complete the exchange capability design is defined in the thesis. The XML document and schema are provided in the appendices.

ALGORITHMIC APPROACHES TO FINDING COVER IN THREE-DIMENSIONAL VIRTUAL ENVIRONMENTS

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In order for an agent to be credible in simulating a human opponent in a first-person combat simulation, it must be able to find and use cover from direct fire weapons. The ability to find cover is fairly intuitive for humans, but current attempts at replicating this ability in computer simulations and video games have been either simplistic or totally missing. This thesis explores a range of algorithms which computer agents can use for finding cover from direct-fire weapons in high-detail, dynamic, three-dimensional environments. The first method treats the enemy as a point light source and uses binary space partition trees to create shadow volumes to find areas of cover. The second method uses a depth-mapping technique to find potential areas where the agent could get behind cover. The third method uses a sensor grid centered on the agent that allows it to check the area around it for cover locations. The sensor grid technique was implemented inside of the first-person shooter computer game *America's Army: Operations* as a proof of concept.

ALTERNATIVE AUDIO SOLUTION TO ENHANCE IMMERSION IN DEPLOYABLE SYNTHETIC ENVIRONMENTS

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The purpose behind this thesis was to examine the effect of vibro-tactile feedback on a user's degree of immersion in a synthetic environment. Sub-woofers usually provide the vibro-tactile feedback in surround sound systems. The alternate method explored in this thesis utilized a "seat shaker" to generate the appropriate tactile feedback in the environment. The solution theoretically enables the user to receive a compelling, multi-modal presentation of the environment with deployable (small footprint), unobtrusive equipment. Physiological responses (electrodermal activity, heart rate, and temperature) were measured in an attempt to determine if there was a statistically significant difference between a user's degree of immersion and emotional response in a 5.2 surround sound environment versus one with stereo headphones and a seat shaker.

A computer based first-person shooter game (*America's Army: Operations*) was utilized as the synthetic environment. The independent variable was vibration delivery method (headphone with no vibration, 5.2 surround sound, headphones with seat shaker). The dependent variables were physiological response.

Results indicated that vibro-tactile feedback did enhance emotional response and therefore immersion. A surround sound system might be effectively replaced by headphones and a seat shaker to achieve the same emotional reaction.

MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

PHYSICALLY BASED MODELING AND SIMULATION OF A SHIP IN OPEN WATER 3-D VIRTUAL ENVIRONMENT

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This thesis addresses the development of a physically based modeling simulator for a ship in a 3-D virtual environment to be used in naval tactical training systems. The objective is to develop a computer simulation program in which physical models are implemented in order to achieve a realistic representation of a ship in a virtual environment, considering its physical features in the presence of environment conditions including waves, ocean current, wind, fog, and day/night issues. The simulator was developed by integrating five marine models with a virtual ocean environment created with a visual simulation builder tool. The marine models include a maneuvering model, a wave model, a wind model, and an ocean current model. The numerical results from another complex wave model were also combined using linear interpolation to increase the realism level of the simulator. The result of this thesis shows that the integration of multiple models from different sources is a feasible approach to meet the application requirements. The result also indicates that the use of the interpolation technique to take advantage of complex models yields a simulator with an acceptable level of realism while imposing very low computational load in the application program.

KEYWORDS: Physically Based Modeling, 3-D Virtual Environment, Ship Maneuvering Simulator, Environment Disturbances

THE ARTILLERY FIRE DIRECTION CENTER SIMULATION

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In recent years, declining budgets, limitations on artillery ammunition, and decreases in training areas have reduced the opportunity to conduct live fire artillery training. For these reasons, simulation systems are available for providing an almost realistic training platform for the forward observer. One of them is "The Forward Observer Personal Computer Simulator (FOPCSIM)," which is the thesis work of two students, David Brannon and Michael Villandre. FOPCSIM is a useful tool for the training of the forward observer without major requirements. However, it is a stand-alone system and many of the actual procedures of the observed fire are provided by the system. This thesis presents another system, which simulates the Fire Direction Center procedures during a firing mission. The two systems have a network communication for exchanging messages, similarly with the real communication messages between the forward observer and the FDC. Now, the training of the forward observer is more realistic because this person must take into account the existence of the FDC, must wait for responses for each message sent out, and must deal with problems such as communication errors, time delays in sending and receiving messages, and modifications in the call for fire from the FDC. The new system will provide feedback by keeping a history of each mission and giving the observer the capability to review the process of each mission and make useful conclusions about performance.

KEYWORDS: Field Artillery, Fire Direction Center, Forward Observer, Call for Fire, FDC, FOPCSIM, Training, Virtual Environment, Fire Support, Simulation

MASTER OF SCIENCE
IN
OPERATIONS RESEARCH

A MULTI-YEAR AMMUNITION PROCUREMENT MODEL FOR DEPARTMENT OF THE NAVY NON-NUCLEAR ORDNANCE

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The Navy Non-nuclear Ordnance Requirements (NNOR) process determines annually the preferred inventory levels for most Department of the Navy munitions. This process is unrestricted by cost. Procurement planners must then apply current budgetary constraints to determine actual purchasing recommendations. This report introduces a metric for quantifying the capability provided by a given inventory of a munition. It then describes an optimization model, the Assessment and Investment Model (AIM), which will generate multi-year purchasing recommendations in order to maximize the capability of the inventory subject to constraints in terms of budget, industrial base, maintenance, and NNOR requirements.

The Navy Ammunition Logistics Center (NALC) is working to replace the current process of generating munitions procurement recommendations. The effort documented in this report was initiated by, and has the support of, NALC as a potential decision-support tool. Initial results show that AIM procurement recommendations are superior to recommendations generated by the current process and will result in a more combat-effective munitions inventory for any given (and, currently, almost $2 billion) Department of the Navy weapon procurement budget.

KEYWORDS: Munitions Procurement, Optimization, Measure of Capability

AN EXPLORATORY ANALYSIS OF LITTORAL COMBAT SHIPS' ABILITY TO PROTECT EXPEDITIONARY STRIKE GROUPS

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Second Reader: LCDR Russell Gottfried, USN, Department of Operations Research

This thesis uses an agent-based simulation model named EINSTein to perform an exploratory study on the feasibility of using Littoral Combat Ships (LCSs) to augment or replace the current defenses of Expeditionary Strike Groups (ESG). Specifically, LCS's ability to help defend ESGs in an anti-access scenario against a high-density small boat attack is simulated. Numbers of CRUDES (CRUiser, DEStroyer, Frigate) ships are removed and LCSs are added to the ESG force structure in varying amounts to identify force mixes that minimize ship losses. In addition, this thesis explores various conceptual capabilities that might be given to LCS. For example, helicopter/Unmanned Combat Aerial Vehicles (helo/UCAVs), stealth technology, close-in high volume firepower, and 50+ knot sprint capability. Using graphical analysis, analysis of variance, and large-sample comparison tests, it is found that being able to control aircraft is the most influential factor for minimizing ship losses. Stealth technology is another significant factor, and the combination of the two is highly effective in reducing ship losses. Close-in high volume firepower is effective only when interacting with helo/UCAVs or stealth. Fifty+ knot sprint capability is potentially detrimental in this scenario. An effective total sum of CRUDES ships and LCS is between five and seven platforms.

OPERATIONS RESEARCH

SELECTIVE OFFLOAD CAPABILITY SIMULATION (SOCS): AN ANALYSIS OF HIGH DENSITY STORAGE CONFIGURATIONS

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Future sea bases, such as the Maritime Prepositioning Force (Future), will serve as key distribution nodes and must be able to sustain forces ashore and selectively offload supplies from storerooms quickly and efficiently. Current MPF ships maximize the available cargo storage onboard and have little ability to selectively offload supplies. To make selective offload a reality, MPF(F) requires lower stowage densities and new technologies to efficiently move items, especially for those supplies needed in direct support of forces ashore. The difficult questions are how dense and in what configurations MPF(F) storerooms can be packed, and how items should be retrieved in order to selectively offload supplies and provide acceptable response time.

The trade-off between storage density and mean retrieval time in a dynamic environment for different storage densities and configurations in notional storerooms aboard a future sea base is analyzed. Two demand scenarios and two different retrieval rules to determine how each storage configuration responds to retrieval requests over time are examined. Results provide insight into the types of storeroom configurations that provide the best mean retrieval times and how a simple retrieval rule can significantly reduce mean retrieval time under certain demand conditions.

UPGRADABLE OPERATIONAL AVAILABILITY FORECASTING TOOL FOR THE U.S. NAVY P-3 REPLACEMENT AIRCRAFT

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The P-3 Orion maritime aircraft has been the U.S. Navy's primary maritime patrol aircraft since its fleet introduction in 1962. Naval Air Systems Command (NAVAIR) has determined that the P-3 fleet has sufficiently aged to warrant a replacement. The replacement aircraft is currently undergoing the conceptual phase of development and it is during this period that NAVAIR is interested in evaluating the trade-off between operational availability and the associated cost to achieve this operational availability. This thesis developed a simulation tool that was used to investigate relationships that affect cost and operational availability of the new (notional) aircraft on a deployment. The simulation tool was exercised for select scenarios in order to gain insights into the value of investing funds in additional aircraft versus the value of investing funds in increased component reliability. The simulation was developed to be very flexible and extensible, enhancing its value for future analyses. Required data inputs into the simulation tool are formatted utilizing a new technology called Extensible Markup Language (XML), which facilitates use of the data in nearly all computer software packages. The model is robust in nature and can be applied to a wide variety of aircraft.

EXPLORATORY ANALYSIS OF SUBMARINE TACTICS FOR MINE DETECTION AND AVOIDANCE

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This thesis provides an initial analytical basis for Tactical Decision Aids in submarine mine detection and avoidance (MDA). Five aspects of submarine MDA are studied. First, a network optimization model plans the best route through a minefield based on prior surveys of bottom clutter (NOn-mine Mine-like Bottom Objects, or NOMBOs). If a submarine is trying to avoid going through a minefield, the second model helps the submarine decide how far to back up if it detects a mine. A third model calculates minimum safe standoff distance for initiating submarine maneuvers around a given mine. This model takes into account submarine maneuvering characteristics and sensor error in the case of onboard sensor detection, or both navigation and mine location errors in the case of reported mine positions. The fourth aspect of the submarine MDA problem uses simulation to study the probability of safe transit based on alternative MDA tactics, various mine and NOMBO densities, and various probabilities of detection. Finally, the simulation examines the probability that a given MDA tactic will result in gridlock, i.e., the probability that a single attempt to penetrate the minefield is blocked by mines or NOMBOs.

MAXIMIZING THE STABILITY OF AN ENSEMBLE OF CLOCKS

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Atomic clocks provide "stable" signals that are mainly used to generate time scales and to measure differences of time between events. Each atomic clock can individually be characterized according to the stability of the scale it produces.

Due to the stochastic behavior of each clock, usually clock ensembles are used to build more stable time scales. This process requires basically two steps. First, it is required to individually characterize each time source to identify the particular noise components present. Second, a measure of performance is required in order to derive an algorithm based on it to properly "weigh" this particular clock in the process of creating a combined scale.

In this thesis, both problems are faced using an operations research approach: each clock is modeled, analyzed, and characterized by a time-dependent measure of performance related to its intrinsic stability, and optimally combined to produce a more stable combined time scale. The optimality criterion is directly related to the spectral characteristics of the noise sources present.

OPERATIONS RESEARCH

A SIMULATION OF THE I3 TO D REPAIR PROCESS AND SPARING OF THE F414-GE-400 JET AIRCRAFT ENGINE

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Second Reader: CDR Kevin J. Maher, USN, Department of Operations Research

The F/A-18E/F is the latest multi-mission tactical aircraft to enter United States Naval Service. It generates power via two F414-GE-400 engines, each of which is composed of six modules. In addition to a new aircraft model and engines, a new concept, the I3 to D Repair Process, is being used for F414-GE-400 module and engine repair. In the I3 to D Repair Process, the intermediate level no longer repairs modules. Instead, the depot level performs all module repairs. This thesis develops and exercises a simulation of the I3 to D Repair Process for the F414-GE-400 by incorporating simulated F/A-18E/F flight schedules and engine failures to populate the repair cycle. The simulation provides operational availability (A0) and probability to spare the repair process given an infrastructure and sparing profile. Three previous years of module failures and depot repair times are used to calibrate the model. Simulation results for the baseline studied showed the distinct influence of certain input parameters. Aircraft service entry time had only a relative short-term effect on A0. Cannibalization of engines among F/A-18s improved A0. Scheduled maintenance dramatically impacted A0. Finally, of all the components of depot repair turn around time (RTAT), "In Work" and "Other" influenced A0 the most. The simulation was also used to examine the impact of varying build windows and depot RTAT. It allows easy changes of input parameters to be made so that a multitude of effects on A0 and probability to spare the repair process can readily be studied.

KEYWORDS: F/A-18, Hornet, F414-GE-400, Jet Aircraft Engine, Simulation, Simkit, Operational Availability, Repair Process, I3 to D

MULTIVARIATE ANALYSIS OF THE EFFECT OF SOURCE OF SUPPLY AND CARRIER ON SHIPPING TIMES FOR ISSUE PRIORITY GROUP ONE (IPG-1) REQUISITIONS

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The objective of this thesis is to examine the effects of source of supply and carrier on shipping times of high-priority requisitions to primary destinations of Navy units in the Pacific Theater and Persian Gulf. The focus was primarily on determining whether source of supply, carrier, and the interaction of these two factors have an effect on shipping times of high-priority requisitions. "Source of supply" refers to Department of Defense supply depots and "carrier" refers to shippers, such as Federal Express® and DHL Worldwide Express®.

This study uses ordinary least square (OLS) linear models, generalized linear models (GLMs) and nonparametric methods to explore the structure of the historical requisition datasets. OLS linear models were found to be inadequate, but both the GLMs and nonparametric tests proved to be valid and yielded results from which inferences could be made. According to the GLMs and nonparametric tests, source of supply has a statistically significant effect on shipping times of high-priority requisitions, but carrier does not. The GLMs also indicated that there is no significant interaction between source of supply and carrier.

KEYWORDS: Requisition Shipping Time, Multivariate Linear Regression, Generalized Linear Models, Nonparametric Analysis, Kruskal-Wallis Rank Sum Test

OPERATIONS RESEARCH

USING AGENT-BASED DISTILLATIONS TO EXPLORE LOGISTICS SUPPORT TO URBAN, HUMANITARIAN ASSISTANCE/DISASTER RELIEF OPERATIONS

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There are two motivations for studying Humanitarian Assistance/Disaster Relief (HA/DR) operations. First, the Marine Corps will be a first-responder in the future. Second, logistics support takes on a primary role. This thesis identifies the potential for using agent-based models to support logistical decision-making in an urban, HA/DR environment. A simulation is developed using Map Aware Non-uniform Automata (MANA). The scenario depicts a relief convoy with security attachment, operating on urban terrain. The convoy moves to an HA/DR site where they distribute food to neutrals (locals) who have made their way to that site.

Data farming is coupled with a Latin Hypercube design of experiment to explore very large data space. Forty variables are identified. Six hundred and forty different design settings are established and each setting is replicated 50 times, producing a 32,000-point dataset. Regression is used to fit several models. The conclusions from this thesis suggest: coupling intelligent designs with data farming is effective at exploring large data space; mission success in HA/DR operations may depend on only a handful of factors; understanding local communications is the key to mission success; and success cannot be determined based solely on the factors the convoy controls.

MASTER OF SCIENCE
IN
PHYSICS

DEMONSTRATION OF A NEAR AND MID-INFRARED QUANTUM WELL INFRARED DETECTOR
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In this thesis a device was designed to ultimately detect a laser designator operating at 1.06 p m and infrared radiation near 10 p m simultaneously. The final design consisted of 25 quantum step wells 80 p m wide. The peak IR absorption coefficient was 1800 cm^{-1} at 11.1 p m with a bandwidth of 1.6 p m. Dark current was measured to be 1.6 x 10^{-8} A at 1 V bias at 10 K and a background photocurrent of 4.6 x 10^{-6} A at 10 K. The background-limited performance of the device occurs at approximately 55 K. The barrier height of the well was 99 meV. The maximum responsivity for each band was measured to be 0.04 A/W at 840 nm and 0.69 A/W at 10.93 p m. Detectivity was then calculated to be 3.4 x 10^{10} $_{cm\sqrt{Hz}/W}$ in the NIR band and 6.5 x 10^{11} $_{cm\sqrt{Hz}/W}$ in the IR band. D* at the background limited point (D*$_{BLIP}$) was 2.0 x 10^{9} $_{cm\sqrt{Hz}/W}$ in the NIR and 3.9 x 10^{10} $_{cm\sqrt{Hz}/W}$ in the IR.

KEYWORDS: Quantum Well Infrared Photodetector, QWIP, FTIR

MASTER OF SCIENCE
IN
SPACE SYSTEMS OPERATIONS

DETECTING AND MEASURING TEMPORAL PHENOMENON WITH HIGH RESOLUTION SATELLITE IMAGERY

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A new operating mode for imaging satellites has been developed. The non-imaging mode is designed to provide high temporal resolution data time varying targets. The idea is to use linear pushbroom arrays with kilohertz sampling rates to not only detect, but also measure the frequency of temporally varying targets. For satellite operations this will involve satellite slewing at a rate which cancels the effects of satellite orbital motion. This concept was explored with a laboratory simulation of an intended test target consisting of windmills at the Ponnequin Wind Farm in Colorado. Test images were acquired and processed using an inexpensive camera and MATLAB. Results indicate the approach is viable and should produce distinct and useful signatures in time and frequency domain analysis.

KEYWORDS: Temporal Phenomenon, Frequency Response, Satellite Imagery

ANALYSIS OF THE NASA SHUTTLE HYPERVELOCITY IMPACT DATABASE

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A statistical analysis of the NASA Space Shuttle Hypervelocity Impact Database to find correlations between meteoroid and orbital debris (M/OD) impacts on the shuttle orbiter fleet and specific mission parameters: Inclination, Altitude, Duration and Year. M/OD impact data, regardless of location, particle type, or mission was examined first, followed by the subcategories of Window data, Radiator data, Reinforced Carbon-Carbon (RCC) data, and Flexible Reusable Surface Insulation (FRSI) data.

In an effort to characterize and evaluate the M/OD environment in low earth orbit, post-flight surveys of the shuttle orbiters are conducted to identify damage caused by hypervelocity impacts from M/OD. Survey analysis determines whether the impactor was a naturally occurring meteoroid or man-made orbital debris, as well as the impactor's size and impact velocity.

From the post-flight survey data, calculations on the number of impacts from specific particle diameters or specific particle materials are made and compared to mission parameters to help engineers design spacecraft for better mission efficiency by reducing the effects of M/OD impacts.

This thesis analyzes the NASA Space Shuttle Hypervelocity Impact Database, using regression analysis software, to find correlations between M/OD impacts on the shuttle orbiter fleet and mission parameters to draw conclusions on what is influencing vehicle damage.

KEYWORDS: Regression Analysis, Space Shuttle, Hypervelocity Impact, Meteoroid, Orbital Debris, Low Earth Orbit

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MASTER OF SCIENCE
IN
SYSTEMS ENGINEERING

SIGNAL SYNTHESIS WITH DYNAMICALLY-CHANGED POWER SPECTRAL DENSITY IN A SOFTWARE DEFINED RADIO TRANSMITTER

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The objective of this thesis is to synthesize signals with a dynamically changing power spectral density, in a Software Defined Radio (SDR) transmitter, utilizing the most appropriate channels, modulation schemes, and transmission rates for communication, based on the noise profile (AWGN plus interferences) of the link, in order to achieve performance within some predefined acceptable levels. The objective is obtained by simulation.

KEYWORDS: Software Defined Radio, RF Section, IF Section, Baseband Section, Dual Quad Programmable Digital-Down-Converter, Dual Quad Programmable Digital-Up-Converter, Analog-to-Digital Converter, Digital-to Analog Converter, Controller, Data Buffer, Interpolation Filter, Decimation Filter, Shaping Filter, CIC Filter, FIR Filter, Root Raised Cosine FIR Filter, Filter Compute Engine, Channel Capacity, MPSK Modulation, Intersymbol Interference

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PERFORMANCE EVALUATION OF THE AN/USQ-146 JAMMER OVER UNCODED SLOW FH/MFSK MILITARY COMMUNICATION SYSTEMS AND THE IEEE 802.11A WIRELESS LAN COMMERCIAL COMMUNICATION STANDARD

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On the modern battlefield communication is critical. Individual units require a steady flow of accurate information between headquarters and field units to remain effective. Just as important, denying the enemy the same needs of communicating with the help of electronic countermeasures (ECM), is essential to success. Communications jamming and surveillance are critical to achieve information superiority. This thesis evaluates the performance and capabilities of one of the most advanced devices that detects, analyzes, and denies enemy signals: the Rockwell Colins AN/USQ-146 transportable communication jammer. The jammer's best strategy varies with respect to the modulation technique that the hostile communication system uses. As the theoretical analysis and the simulation results indicated, the AN/USQ-146 jammer achieves its best performance over a FH/MFSK system when it selects the repeat multitone jamming strategy. However, when the hostile communication system is the IEEE 802.11a wireless local area network (WLAN) system, the AN/USQ-146 (Rubicon II) jammer must select the partial-band jamming strategy with p = 0.1. The results of the theoretical analysis and the simulation modeling of the specific jammer for all types of jamming in manual spot and repeat modes over FH/MFSK military communication systems and new advanced wireless standards, such as the IEEE 802.11a, can be used as guidelines to select the most effective jamming strategy for the specific type of hostile waveform encountered.

REFRACTIVE CONDITIONS OF AMAZON ENVIRONMENT AND ITS EFFECTS ON GROUND AND AIRBORNE RADAR AND ESM SYSTEMS

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This is a study of abnormal refractive layer occurrence over the Amazon region and possible effects on radar and ESM systems, ground or airborne based. Climatologic data from three stations in that region are analyzed using computations from the Global Tropospheric Experiment (GTE), soundings and satellite imagery. The GTE data provide monthly occurrences and seasonality of atmospheric ducts and superrefractive layers. Further, individual soundings from the March-June 2003 period and the Advanced Refractive Effects Prediction Systems (AREPS) 2.1 software are used in a case study that analyzed these layers and, in addition, subrefractive and multiple layers. Selected soundings were used in simulations to explain the effects of different types of abnormal layers on the electromagnetic propagation. Although ground systems were not affected by abnormal layers, airborne were. A region with low or no detection is created; even an abnormal layer refracts the electromagnetic energy upwards or downwards. Some combinations of multiple layers may cause even stronger effects. It is concluded that knowledge of the abnormal layers occurrence is important for operations in the Amazon region. Further, airborne radar platforms should measure local refractive conditions, if possible. A comprehensive study in time and space is recommended to provide forecasting.

DISTRIBUTED SUBARRAY ANTENNAS FOR MULTIFUNCTION PHASED-ARRAY RADAR

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As the target radar cross section (RCS) continuously decreases, the need for high-resolution high-gain radar increases. One approach to high resolution is to use distributed subarray antennas (DSAs), because of limited surface available on many radar platforms.

The concept of distributed subarray antennas is examined for both Multifunction Array Radar (MFAR) and Very High Frequency (VHF) applications. By combining distributed subarrays located on the available areas of a constrained platform, the MFAR and VHF DSA can achieve increased resolution and potential reductions in cost and complexity compared to a conventional array. The two-way pattern design of DSA effectively suppresses the undesired grating lobes by using separate transmit and receive antennas. By the pattern multiplication principle, the grating lobes in the subarray receive pattern have been suppressed by proper null placement of subarray in the receive and transmit antenna patterns.

CLASSIFICATION AND ANALYSIS OF LOW PROBABILITY OF INTERCEPT RADAR SIGNALS USING IMAGE PROCESSING

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The characteristic of low probability of intercept (LPI) radar makes it difficult to intercept with conventional signal intelligence methods, so new interception methods need to be developed. This thesis initially describes a simulation of a polytime phase–coded LPI signal. The thesis then introduces a method for classification of LPI radar signals. The method utilizes a parallel tree structure with three separate "branches" to exploit the image representation formed by three separate detection methods. Each detection method output is pre-processed and features are extracted using image processing. After processing the images, they are each fed into three separate neural networks to be classified. The classification output of each neural network is then combined and fed into a fourth neural network performing the final classification. The outcome of testing shows only 53%, which might be the result of the image representation of the detection methods not being distinct enough, the pre–processing / feature extraction not being able to extract relevant information, or the neural networks not being properly trained. The thesis concludes with a brief discussion about a suitable method for image processing to extract significant parameters from a LPI signal.

KEYWORDS: Signal Processing, Image Processing, LPI, LPI Radar Signals, Classification

WIRELESS CONTENT REPURPOSING ARCHITECTURE FOR DC COMMAND AND CONTROL

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Damage control communications should be improved onboard U.S. Navy ships. Current standard operating procedures are antiquated and should be replaced. Wireless networks are an improvement over the status quo and mobile devices offer new capabilities that greatly improve the situational awareness for team members.

In this thesis, a system architecture is designed for a damage control wireless local area network with Commercial-Off-the-Shelf components. This makes the system affordable and prevents previous miscommunications from occurring.

The ability to view the information on different devices effectively is a unique problem to the mobile user and requires the use of content repurposing at the server.

KEYWORDS: Wireless Local Area Networks, Damage Control

INFORMATION OPERATIONS IN STRATEGIC, OPERATIONAL, AND TACTICAL LEVELS OF WAR: A BALANCED SYSTEMATIC APPROACH

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This thesis explores the idea whether a balanced systematic approach is a better way to integrate Information Operations (IO) at different levels of war compared to uncoordinated efforts at each level. Analysis of the role of information in a conflict in the context of information superiority provides the foundation of the thesis. DoD's IO core, supporting, and related capability based approach was used in the analysis of each level of warfare. Strategic, operational, and tactical level IO were analyzed by matching relevant IO capabilities with the IO effects desired at the respective levels. Sample systems were provided for each capability when appropriate. IO efforts in Operation Desert Storm and Operation Allied Force were analyzed. This thesis concluded that a balanced systematic approach to IO through its integration at all three levels of warfare will produce much better results than the uncoordinated cases in order to exploit the integrative effect of IO on the instruments of national power and the military capabilities at different levels of warfare.

KEYWORDS: Information Operations, Information Superiority, Levels of Warfare, Operation Desert Storm, Operation Allied Force

SMART TRANSPORT-A SURVEY OF TRACKING TECHNOLOGIES FOR CARGO CONTAINERS AND THEIR TRANSPORT PLATFORMS

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As the threat of terrorism rises, nations seek solutions to secure their ports and lanes of commerce upon the world's oceans and skies. The transport industry has taken the lead in developing new technologies to track cargo containers and the transport platforms, for billions of dollars are at stake. This thesis examines the present and future communication and tracking systems used by the transport industry. Furthermore, an investigation into the tracking methods for high-value items such as diamonds will be disclosed. By analyzing the communication and tracking systems used by the transport industry, elements of the Homeland Security organization can mitigate terrorism on the lanes of commerce and ultimately prevent weapons of mass destruction from entering the United States.

KEYWORDS: Cargo Container Tracking, Radio Frequency Identification, E-seals, Satellites, Diamonds

OPNET/STK INTEGRATED ENVIRONMENT FOR MODELING AN UAV NETWORK

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In this thesis, an OPNET/STK integrated model is used as an example to demonstrate the development of an UAV communication network. First, the concept of using an UAV as a mobile node in a network is addressed. Second, both OPNET and STK modeling tools are described in a separate chapter to describe each individual modeling characteristic. Third, an OPNET/STK integrated model is illustrated to show the

characteristics of a combined environment and to analyze the interoperability and performance of this combined model. Finally, some recommendations and conclusions are stated for further study.

KEYWORDS: OPNET, STK, C4I, HALE, UAV, Global Hawk, Wireless Communications, Network Centric Warfare, Network Centric Operation, Military Satellite Communication, Computer Models

RADAR ABSORBING MATERIAL DESIGN
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Low observable platforms have extremely low radar cross section specifications that cannot be achieved by shaping alone. The application of radar absorbing material is necessary, in which case the appropriate constitutive parameters and thickness must be selected. The universal design chart gives combinations of p, h and t that provide zero specular reflection at normal incidence. Three different backing materials were used to generate the charts: (1) perfect electric conductor, (2) free space, and (3) graphite. One can pick the required values from the charts for an ideal zero reflection dielectric/magnetic layer. The extension to other materials is straightforward. Numerical simulations of coated plates were performed to estimate the effectiveness of the absorbing layers in reducing radar cross section. The reduction in monostatic radar cross section value is shown by plotting the radar cross section of the plate with and without radar absorbing material.

KEYWORDS: Radar Cross Section Reduction Techniques, Radar Absorbing Materials, Matched Surface RAM, Universal Design Charts

SOFTWARE DEFINED RADIO DATALINK IMPLEMENTATION USING PC-TYPE COMPUTERS
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Master of Sciences in Systems Engineering-September 2003
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The objective of this thesis was to examine the feasibility of implementation and the performance of a Software Defined Radio datalink, using a common PC type host computer and a high level programming language. Dedicated transceivers were used, plugged on the PCI bus of host PCs running Windows 2000. Most of the functionality was programmed using the Microsoft Visual C++ language. The tasks to be performed included the channels configuration (number of active channels, center frequencies, sampling and data rates, choice of the appropriate up and down conversion filters), the management of the data transfer between the host computer and the transceiver, the baseband data modulation and demodulation, and the data organization into packets with appropriate headers in order to achieve phase and time synchronization solely by software. A part of the transceivers' configuration was achieved using a configuration utility running in Excel, provided by the manufacturer. Several combinations of M-PSK modulation schemes, channel numbers and datarates were tested in order to measure the performance limits of the system and its ability to perform the required tasks in real-time. The received data streams were further analyzed with the use of Matlab in order to verify the proper functionality of the communication scheme.

KEYWORDS: Software Defined Radio, Communications, Datalink, WaveRunner

MASTER OF SCIENCE
IN
SYSTEMS ENGINEERING MANAGEMENT

TEST AND EVALUATION IN THE UNITED STATES NAVY, AND HOW IT MUST EVOLVE TO SUPPORT FUTURE SYSTEMS ACQUISITION
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Modern Test and Evaluation (T&E) has long supported acquisition of warfighting systems in the United States Navy. As the complexity and long-term supportability of these systems has dramatically increased, the need to successfully and incrementally test and evaluate families of systems, including their interfaces, has become even more critical. Long established techniques and methodologies for T&E may still apply, but new factors must be addressed. As the Navy continues to grapple with acquisition reform, and aims to transform itself in the future, the Warfighters' needs have essentially remained the same – delivery of the best, most effective weapons, as soon as possible, and made easy to operate and maintain. Without an equally effective developmental and operational test and evaluation process, the United States Navy cannot satisfy this need.

This thesis examines T&E today and where it must go in the future. It provides recommendations for T&E enhancements, and explores several areas where the Navy, and Joint Services, is already looking towards future, integrated and collaborative test and evaluation.

KEYWORDS: Test and Evaluation, Open Systems, Open Architecture, System Engineering, Engineering Discipline, AEGIS, AEGIS Weapon System

A QUALITATIVE ASSESSMENT AND ANALYSIS OF STAKEHOLDER EXPECTATIONS
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A Department of Defense acquisition program is influenced by a large number of external stakeholders, including operational users, oversight authorities, contractors and suppliers, and interfacing program managers. Key stakeholders will readily agree that meeting the Warfighting needs of operational users is the primary objective of an acquisition program, however, many stakeholders have developed their own strategies to achieve that goal. The job of the program manager within the acquisition system is to deliver a product that best meets stakeholder expectations (the right product delivered the right way). This research defines a methodology for eliciting strategic inputs from key stakeholders associated with an acquisition program. The methodology includes an environmental analysis leading to identification of key stakeholders and focus areas for stakeholder interviews. The methodology is applied to the Global Command and Control System-Maritime program to obtain stakeholder input targeted for future strategic plans.

KEYWORDS: C4I Systems Development, Product Development, Stakeholder Interview, Stakeholder Feedback

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MASTER OF SCIENCE
IN
SYSTEMS TECHNOLOGY

ORGANIZATIONAL CHANGE FOR THE INTELLIGENCE COMMUNITY SUPPORTING MARITIME HOMELAND SECURITY AND DEFENSE: DEVELOPING A DOMESTIC MARITIME INTELLIGENCE NETWORK
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Since the beginning of the twentieth century, the United States has conducted the missions of Homeland Security and Defense abroad, rather than within its borders. While keeping conflict outside of U.S. borders is preferred, the terrorist attacks that occurred on September 11, 2001 have illustrated that this is not always possible. The missions of Maritime Homeland Security and Defense have gained significant importance in the overall national security of the United States. In order to effectively support these missions, an effective intelligence apparatus must exist which is adapted to the Information Age. Terrorist groups are using the network forms of organization, with significant advantages over traditional hierarchies within the U.S. government. Effectively organizing the various agencies involved in domestic maritime intelligence will require rapid movement of intelligence to the operational customer. The most effective way to organize these agencies to support Maritime Homeland Security and Defense is to create a domestic maritime intelligence network.

KEYWORDS: TERMS, Maritime Homeland Security, Maritime Homeland Defense, Intelligence, Network, Organizational Structure, Terrorism

MASTER OF ARTS

National Security Affairs

MASTER OF ARTS
IN
NATIONAL SECURITY AFFAIRS

NATO'S WEAPONS OF MASS DESTRUCTION INITIATIVE: ACHIEVEMENTS AND CHALLENGES

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This thesis analyzes the Weapons of Mass Destruction Initiative (WMDI) taken by the North Atlantic Treaty Organization (NATO) in April 1999. The analysis considers the achievements of the WMDI as well as the obstacles and challenges the Alliance faces in countering WMD threats. For over a decade, the Alliance has been concerned about threats posed by biological, chemical, nuclear, and radiological weapons. In 1994, NATO established the Senior Political-Military Group on Proliferation and the Senior Defense Group on Proliferation to implement alliance policy on WMD proliferation. Through the WMDI, NATO enhanced its efforts to address these threats through the establishment of a WMD Center at NATO Headquarters in Brussels, to facilitate dialogue and coordination relating to threat assessment and to develop responses to such threats. At the Prague Summit in November 2002, the Allies made firmer commitments to develop capabilities to respond to WMD threats. The new measures include the Prague Capabilities Commitment and the NATO Response Force.

KEYWORDS: NATO, Weapons of Mass Destruction, Initiative

UNITED STATES LAND BORDER SECURITY POLICY: THE NATIONAL SECURITY IMPLICATIONS OF 9/11 ON THE "NATION OF IMMIGRANTS" AND FREE TRADE IN NORTH AMERICA

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The 9/11 terrorist attacks spawned heated debates about border security roles in preventing terrorism. The United States is generally known as a "nation of immigrants," welcoming those seeking economic and religious freedom. This thesis explores the effects of three policy options (increased manpower/financial resources for border inspection agencies, technology, and private sector-government cooperation) on the prevention of terrorism within U.S. borders. It also explores the effects of those policy options on trade flows and the movement of legitimate people across international borders. Scope is limited to land border security policy from 1990-2003. Three case studies are included: (1) the Border Patrol's "prevention through deterrence" strategy, which began in 1994 and benefited from a monumental increase in manpower/financial resources to the INS; (2) an analysis of which border technology options are the most secure and inexpensive means of preventing illegal immigration, stopping the introduction of contraband into the United States, and maintaining legitimate flows of commerce/people that have increased since the passage of NAFTA; and, (3) an analysis of why private sector-governmental partnerships that both increase transportation security while lowering border wait times developed on the U.S.-Canadian border, but not on the U.S.-Mexican border. Implications are drawn for U.S. policymakers.

KEYWORDS: Border Security, Illegal Immigration, NAFTA, Free Trade, Mexico, Canada, Border Patrol, INS, Terrorism, Cooperation, C-TPAT, SENTRI, Biometric Identification

THE SHANGHAI COOPERATION ORGANIZATION: ORIGINS AND IMPLICATIONS

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This thesis examines the origins and implications of the Shanghai Cooperation Organization (SCO) established in 2001 by China, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, and Uzbekistan. It analyzes the organization from the Chinese, Russian, and Central Asian states' perspective. Chinese and Russian motives for creating the SCO appear to have been threefold. First, both sought an organization dedicated to providing security and stability to the Central Asian region. Second, both wished to foster stronger economic ties with the oil and natural gas-rich former Soviet republics. Finally, both favored stemming the influence of external powers, notably the United States. The Central Asian states' motives for joining the SCO emanate from security and economic needs. The increase in the U.S. military presence in the region since October 2001 has drawn no response from the SCO. Although some Russian politicians and military officers have criticized it, the governments of China and Russia seem to realize that the U.S. presence may help bring stability to the Central Asian region. Many uncertainties burden the SCO's future. It may constitute another failed attempt to establish a security alliance or turn into a significant voice in international politics, especially with the inclusion of additional members.

KEYWORDS: Shanghai Cooperation Organization, Central Asia, Anti-terrorism, Islamic Extremism, Regional Security

U.S.-CHINA RELATIONS: COMMUNICATION AND MISPERCEPTION IN THE TAIWAN STRAIGHT

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Taiwan's political status remains the central, most difficult issue in U.S.-China relations. The question has created tensions that erupted in three crises of direct confrontation between the United States and China in the Taiwan Strait. The central dilemma in solving these conflicts has been that both states tied vital national interests to the issue. Despite the fact that both sides have managed to avoid the Taiwan question when negotiating agreements in less sensitive areas, Taiwan's status continues to present the greatest risk factor for a future, armed conflict between the United States and China. This thesis examines the three Taiwan Strait crises and argues that experiential learning coupled with a realpolitik view of international relations has led decision-makers to follow consistent modes of behavior when handling them. The development of positive relations between the United States and China after 1971 has not mitigated the inherent risks presented by the Taiwan question. The thesis concludes that the value of strategic ambiguity is overestimated, given the likelihood of misperception by both parties in a mutual deterrence relationship. Since a future crisis may not be averted, the United States and China must develop robust lines of diplomatic communication to avoid inadvertent escalation.

KEYWORDS: Taiwan, People's Republic of China, Cross-Strait Relations, Deterrence, Strategic Culture, Strategic Ambiguity, Learning Behavior, Coercive Bargaining, Taiwan Strait Crisis, U.S. Foreign Policy, Chinese Foreign Policy

U.S. MILITARY PRESENCE IN LATIN AMERICA: MAKING THE MANTA FORWARD OPERATING LOCATION WORK

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The U.S. military's regional concerns in the 1990s focused on the drug war, improving interoperability, and carrying out regional engagement. In the new millennium, military activities have expanded to encompass a growing concern with Colombia's drug problem and the "war on terrorism." After the closure of Howard Air Force Base, Panama, the U.S. established forward operating locations (FOLs) as tools for the realization of its goals in the region.

This thesis examines both the international and domestic politics involved when establishing FOLs in Latin America and its implications for future efforts in the region. It focuses on the Manta FOL because it is essential for U.S. strategy in Colombia and best illustrates the challenges of dealing with local opposition to a U.S. military presence. This thesis concludes that Manta is viable because it is more cost-effective, improves military-to-military relations, and demonstrates the existence of external influence upon actors of domestic politics, which can be used as a bargaining asset to sustain its military presence. It is important to understand why the Manta FOL was a success, in order to create a model when establishing future FOL agreements in the region.

KEYWORDS: U.S.-Latin American Relations, Latin America, Forward Operating Locations, Manta, Ecuador, Counternarcotics Missions

CORRELATION OF IDENTITY AND INTEREST IN FOREIGN POLICY: IMPLICATIONS FOR MONGOLIA

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Since the collapse of the Communist bloc, Mongolia has pursued the independent foreign policy with balanced relations attached to the two great neighbors-Russia and China. Meanwhile, the search for a "third neighbor" (the United States, Japan and/or the collective community of democracies) has been seen as the alternative approach to the existing "neighbor-oriented" policy. The thesis argues that both approaches are not mutually exclusive schools of foreign policy, but rather constitute the common approach that is described within this research as "bufferism."

To present an alternative vision of the nation's foreign policy orientation, the thesis covers the major schools of international relations and identifies the two major causes of policy: identity (based on constructivism) and interest (based on realism). As a nation, Mongolia faces the identity trilemma and the security dilemma, without much preference given to any of these options during the last decade. Hence appears the nation's ambiguity in identity, security, and economic development. The thesis puts the argument that without prioritizing one option, Mongolia faces the risk of degrading into a failing state isolated from global affairs. Thus, the reconciliation of its identity and interest, as well as of its aspirations, must lead to a rational choice of a Sino-centric East Asian policy dimension over any other.

KEYWORDS: Foreign Policy, Foreign Policy Factors, Foreign Policy Equilibrium, Identity, Interest, Small States, Mongolia, Buffer, Russia, China, United States, Globalization, East Asia, Central Asia, Eurasia, Southeast Asia, Northeast Asia, Regionalism

EXPOSING THE SEAMS: THE IMPETUS FOR REFORMING U.S. COUNTERINTELLIGENCE

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U.S. counterintelligence is in need of reform. The September 11, 2001 attacks against America by Al-Qa'ida highlight this fact but are not in themselves the reason counterintelligence should be reformed. Not surprisingly, these attacks have stirred a general debate on how U.S. intelligence ought to be reformed to more adequately protect the nation. However, amidst these various discussions one aspect of American intelligence capabilities seems to be conspicuously absent: counterintelligence. A review of counterintelligence functions and organization reveals that U.S. counterintelligence must be reformed organizationally. The current counterintelligence community structure hinders the effective employment of this crucial intelligence capability. In order to resolve this problem, the author proposes a threefold approach to that reform: (1) centralize U.S. counterintelligence operations under a single agency that will have the authority to conduct both domestic and foreign operations, (2) leave the remaining offices of counterintelligence located throughout the federal government in place to provide investigative and analytical support to the central operations agency, and (3) devolve U.S. counterintelligence down to the state and local levels, along with encouraging greater private sector participation, in order to provide wider coverage of the threats that both spies and terrorists pose to U.S. national security.

KEYWORDS: Counterintelligence, Intelligence Reform, Espionage, Spies, Spying, Counterespionage, Foreign Intelligence Services, Double Agents, Moles, Terrorism, Counterterrorism, September 11, 9/11, Terrorists

A HOUSE DIVIDED: THE DECLINE AND FALL OF MASYUMI (1950–1956)

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This thesis analyzes the rise and fall of Masyumi during the era of the provisional parliament in Indonesia (1950-1956). As the largest of the pre-Suharto Islamic political parties in a country with an overwhelming Muslim majority, Masyumi was poised in 1955 to achieve political ascendancy, and thus to achieve its primary objective of establishing an Islamic state. Ultimately, Masyumi's leaders failed to unify Indonesian Muslims, and they consequently lost much of their moral and political authority. In an important demonstration of the malleability of Islamic and ethnic identity politics, Masyumi's struggle was eventually submerged within a greater struggle by the Javanese to assert cultural hegemony over the entire Indonesian archipelago. This thesis describes Masyumi's role in precipitating not only its own fall, but also in helping to bring about the collapse of Indonesia's first attempt at parliamentary democracy.

Indonesia's Islamist past contains many important lessons for U.S. policymakers dealing with this largest of all Muslim countries, particularly in light of the war on terror. Understanding the contingent and variable nature of Masyumi's Islamic politics can help shed light on the present ideological battles in Indonesia.

KEYWORDS: Indonesia, Islam, Islamist, Masyumi, Muhammadiyah, Nahdatul Ulama

IS SAUDI ARABIA A NUCLEAR THREAT?

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Saudi Arabia may become one of the next states to acquire nuclear weapons. The Saudis have the challenge of securing a large border area with a relatively small populace against several regional adversaries. The 1979 Iranian Revolution and subsequent overthrow of the Shah, a U.S. ally, sent shockwaves across the Gulf states and prompted the Saudis to increase defense spending and purchase the longest-range ballistic missile in the Gulf region: the Chinese CSS-2. These missiles have since reached the end of their lifecycle and the Saudi regime is now considering their replacement.

This thesis examines the potential for the Saudis to replace their aging missile force with a nuclear-tipped inventory. The United States has provided for the external security of the oil Kingdom through informal security agreements, but a deterioration in U.S.-Saudi relations may compel the Saudis to acquire nuclear weapons in order to deter the ballistic missile and WMD threats posed by its regional adversaries. Saudi Arabia has been a key pillar of the U.S. strategy in the Persian Gulf. However, a nuclear-armed Saudi Arabia would undermine the international nonproliferation regime and would trigger a destabilizing arms race in the region.

KEYWORDS: Saudi Arabia, Proliferation, Nuclear Weapons, Ballistic Missiles

OCEANS APART: THE UNITED STATES, THE EUROPEAN UNION AND THE INTERNATIONAL CRIMINAL COURT

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Both the United States and the European Union support the promotion of international justice, yet disagree over the utility of the International Criminal Court. The controversy that the Court has generated among members of the long-standing trans-Atlantic partnership is indicative of deeper differences between the United States and EU members and it has the potential to threaten alliance cohesion. This thesis examines American policy toward the Court and its foundations, as well as the actions taken since the May 2002 withdrawal of the U.S. signature to the Rome Statute establishing the ICC. It then reviews EU policies toward the Court and their foundations, focusing on reactions to American policies and to the controversy associated with U.S. actions since the May 2002 withdrawal. The thesis analyzes the dispute between the United States and the EU over the ICC, focusing on the disparity in power, the roles of sovereignty and the U.N. Security Council, disagreements over means of achieving agreed ends in international law, the dispute's politicized nature, and the degree to which both sides seem to be "talking past one another." Finally, the thesis evaluates scenarios for the Court's development and their potential effects on European-American relations, and offers recommendations.

KEYWORDS: International Criminal Court, ICC, American Servicemembers' Protection Act of 2002, Transatlantic Relations, International Institutions, Unilateralism, Multilateralism, Strategic Cultures, United Nations, NATO, European Union, United States

IS IRAN RIPE FOR A NEW REVOLUTION?
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Many Middle East observers have been pondering Iran's future. History has been unkind to those seeking to predict the course of Iranian politics. Robert Gurr, in his book "Why Men Rebel," suggests the use of "Relative Deprivation" theory as a framework to analyze the potential for politicization of social discontent. Some aspects of "Relative Deprivation" are therefore applied to Iran in order to examine the prospects of regime change in Teheran. A large population born mostly after the 1979 revolution, the advent of reformists like Mohammed Khatami, and various geopolitical events in recent years serve as key issues in the application of "Relative Deprivation" towards Iran.

KEYWORDS: Iran, Reformists, Relative Deprivation, Gurr, Regime Change

COUNTERPROLIFERATION STRATEGY: THE ROLE OF PREVENTIVE WAR, PREVENTIVE STRIKES, AND INTERDICTION
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This thesis analyzes the potential effectiveness of preventive war, preventive strikes, and interdiction as tools for the United States to counter the proliferation of weapons of mass destruction (WMD). Examination of these three counterproliferation techniques is important because the George W. Bush administration has given more prominence to military operations to deal with WMD threats. Six historical cases of preventive war, preventive strikes, and interdiction against adversarial WMD programs are examined to show the conditions that make military options desirable and effective and the issues that make their implementation difficult. These case studies reveal that interdiction and preventive strikes are viable and can be effective under very limited legal, political, and military circumstances. Although the United States successfully conducted a preventive war against Saddam Hussein's Iraq, this strategy is not likely to succeed in the cases of Iran and North Korea.

KEYWORDS: Preventive War, Preventive Strikes, Preemptive Strikes, Interdiction, Iraq, North Korea, China, Soviet Union, Second World War, Counterproliferation, Weapons of Mass Destruction

THE U.S. NAVY AND EUROPEAN SECURITY: FROM THE COLD WAR TO THE WAR ON TERRORISM
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This thesis analyzes the determinants of change in the doctrine and force structure of United States naval forces in Europe from the publication of the Maritime Strategy in 1986 to the contemporary post-11 September 2001 security environment. Four factors are examined as possible determinants of change: (1) geopolitics, including changes in the political and security environment in Europe; (2) inter-service competition for resources, influenced by congressionally mandated jointness in military operations; (3) the influence of key policy-makers in the United States political and military command structure, including the U.S. Navy, the Department of Defense, and elected officials of both the executive and the legislative

branches; and, (4) relations between the United States and its NATO Allies. The thesis concludes that certain factors were more influential than others in specific circumstances, but all contributed to shaping doctrine and force structure.

MISSILE DEFENSE FOR TAIWAN: IMPLICATIONS FOR U.S. SECURITY INTERESTS IN EAST ASIA

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The potential provision of Ballistic Missile Defense (BMD) capabilities to the Republic of China (ROC) n Taiwan carries an array of implications for U.S. interests and purposes in East Asia. Although missile defense would assist Taiwan in defending itself from Chinese ballistic missiles, it could generate adverse repercussions that impede Washington's ability to meet its strategic and foreign policy goals.

This thesis addresses how the delivery of BMD to Taiwan might affect U.S. security interests in East Asia. Beijing's long-held fears of U.S. "hegemony" and containment may incite China to undertake political, strategic, or armed courses or action contrary to U.S. interests. Closer defense ties between Taipei and Washington might also jeopardize the ambiguity of the U.S.-China-Japan strategic triangular relationship, thereby weakening regional stability. Additionally, Japan may encounter difficulties in reconciling its role in a possible crisis in the Taiwan Strait, producing complications for the U.S.-Japan security alliance. Lastly, BMD in Taiwan could have unfavorable consequences for Washington's national security strategy, particularly its desires to stem the proliferation of weapons of mass destruction and to foster cooperative relationships with other nations.

KEYWORDS: Ballistic Missile Defense, People's Republic of China, Republic of China on Taiwan, Japan, East Asia, Ballistic Missiles, Taiwan Strait

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